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SOFTWOOD TREE VOLUME EQUATIONS FOR MAJOR CALIFORNIA SPECIES

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ABSTRACT

New cubic-foot, International 1/4-inch board-foot, and Scribner board-foot tree volume equations and tables are presented for eight species: Douglas-fir, Jeffrey pine, ponderosa pine, sugar pine, lodgepole pine, white fir, California red fir, and incense-cedar.

KEYWORDS: Cubic-foot volume tables (stand), board-foot stand volume tables.

INTRODUCTION

We have developed, for use in the Forest Survey of California,^{1/} new cubic-foot, International 1/4-inch board-foot, and Scribner board-foot tree volume equations for eight conifer species: Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), ponderosa pine (*Pinus ponderosa* Laws.), Jeffrey pine (*Pinus jeffreyi* Grev. & Balf.), sugar pine (*Pinus lambertiana* Dougl.), lodgepole pine (*Pinus contorta* Dougl.), white fir (*Abies concolor* (Gord. & Glend.) Lindl.), California red fir (*Abies magnifica* A. Murr.), and incense-cedar (*Libocedrus decurrens* Torr.).

Previously, Forest Survey has relied on a series of local volume tables (California Forest and Range Experiment Station, Forest Survey 1956) to compile timber volume statistics for California.^{2/} These tables assume average heights and form classes by site class based on Forest Survey data collected in the 1940's. The old tables no longer meet Forest Survey needs because (1) we are now interested in an accurate assessment of the volume on individual plots, for which we need volume estimates that take into account individual tree height variation; (2) height over d.b.h. and form class over d.b.h. ratios based on 25-year-old data may not accurately describe today's forest; and (3) the International 1/4-inch board-foot local volume tables assume a top utilization that does not conform with Forest Survey standards.

To replace the old tables, we needed volume equations that would provide comparable estimates of cubic, International 1/4-inch, and Scribner volume to Forest Survey utilization standards. The only existing tables suitable for statewide use (Clements and others 1949a, 1949b) were available only for the Scribner rule and varied by merchantable log height--a variable that is less desirable than total height for use on permanent plots. We therefore chose to develop our own equations.

THE BASIC DATA

Our need was for volume equations suitable for use on trees throughout California. Ideally, for this purpose, we would have preferred a large sample of recently measured trees, drawn from the complete range of forest conditions found in the State. In practice, we were limited to available tree measurement data, since we had neither time nor funds to undertake our own measurements. The most readily available tree measurement data were assembled by Clements and others (1949a, 1949b) during the preparation of their form class volume tables for ponderosa pine, Douglas-fir, white fir, sugar pine, and red fir. The tables themselves are inadequate for our purposes because they are based on log height rather than total height and because they are developed only for the Scribner log rule. However, complete stem profiles are available for all the 2,110 trees used to develop the tables.

^{1/} A nationwide project of the U.S. Forest Service. The Pacific Northwest Forest and Range Experiment Station conducts the survey in Alaska, California, Hawaii, Oregon, and Washington.

^{2/} Unpublished cubic and International 1/4-inch rule volume tables on file at the Pacific Northwest Forest and Range Experiment Station.

The felled tree measurements used for the form class volume tables were, for the most part, taken 50-70 years ago. Both young- and old-growth trees were included from a range of sites scattered from the Modoc plateau south along the Sierra Nevada to the Sierra National Forest. To this sample, we added 957 dendrometer-measured trees from recent inventories of the Eldorado and Sierra National Forests. The latter trees included small samples of lodgepole pine and incense cedar--two species not included in the form class volume tables.

Although the size of our sample was more than adequate, the reader should be aware of some important data deficiencies. First, two-thirds of the sample was drawn from trees measured many years ago. While we recognized the danger of bias inherent in the use of old data, that risk seemed preferable to relying on a much smaller sample with a limited geographical distribution. Second, we were unable to find measured-tree data from the Coast Ranges or, more important, for trees under 11.0 inches in diameter breast high. In the case of California red fir, all our sample trees were over 14 inches. This lack of small-tree data posed a particular problem in developing cubic-foot equations, since volumes were needed for all trees 5.0 inches and larger. We were forced to extrapolate, using comparisons of existing tables as a guide to reasonableness. Finally, our sample data for lodgepole pine and incense cedar were limited--26 trees of the former species and 46 of the latter--and confined to the southern Sierra Nevada. In spite of these scanty data, we decided to develop volume equations for both species, as an alternative preferable to using equations developed for some other species.

DEVELOPING THE EQUATIONS

The STX program (Grosenbaugh 1967) was used to calculate three volumes for each of the sample trees: (1) CV_4 --cubic-foot volume to a 4-inch minimum top d.i.b., (2) $IV_{1/4, 6.5}$ --International 1/4-inch board-foot volume to a 6.5-inch minimum top d.i.b., and (3) SV_U --Scribner board-foot volume to a California utilized top as defined by a 1945 Forest Service study (California Forest and Range Experiment Station, Forest Survey 1956). The relationship of the utilized top d.i.b. to d.b.h. is shown in figure 1.

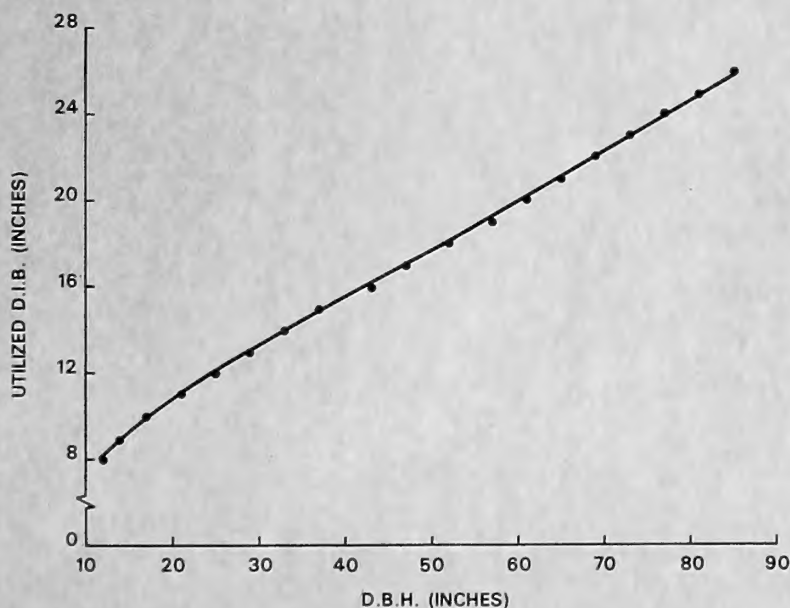


Figure 1.--Relation-
ship of utilized
top d.i.b. to
d.b.h. (Based on
1945 Forest Service
study.)

The method of analysis was essentially that used by Bruce and DeMars (1974). For each species and each log rule, tree volumes were fitted by weighted least squares by means of a stepwise multiple regression analysis. In order to obtain homogeneity of variance, each variable was divided by $0.005454154 (d.b.h.)^2$ (total height)--the volume of a cylinder with a basal area and height equal to that of the sample tree. Our choice of independent variables was limited by the information available about the sample trees. Variables tested included d.b.h., total height, their powers, and cross products. Site class and age class (young growth or old growth) were also tried but dropped because their relative contribution to precision was small and their inclusion in the equations would have required the user to obtain site and age information.

The volume equations follow. Where applicable, restraints have been added to insure reasonable extrapolation. The following symbols have been used:

- V = volume
- D = diameter breast high
- H = total height
- F = form factor (the ratio of a tree's volume to that of a cylinder of the same diameter and height)
- CF₄ = cubic-foot form factor
- IF1/4_{6.5} = International 1/4-inch board-foot form factor to a 6.5-inch top d.i.b.
- SF_u = Scribner form factor (16-foot logs) to a California utilized top.^{3/}

To determine the volume of a given tree, first calculate the tree form factor, (transformed volume) using the appropriate equation for the species. Then multiply the form factor by the volume of a cylinder with the same height and basal area as the tree. Thus: $V = 0.005454154 D^2 H F$, where F is equal to the form factor appropriate for the species and log rule. The form factor equations are:

<u>Species</u>	<u>Equation</u>
Douglas-fir	$CF_4^{4/} = 0.248569 + 0.0253524 \left(\frac{H}{D}\right) - 0.0000560175 \left(\frac{H^2}{D}\right)$ $IF1/4_{6.5} \text{ (when } H \geq 57 \text{ feet)} = 1.575350 - 1269.84 \left(\frac{1}{DH}\right) + 20.4816 \left(\frac{1}{D}\right) + 0.0000135387 H^2$

^{3/} See figure 1.

^{4/} For all species except incense-cedar, CF₄ will be set equal to 0.4 whenever the equation value is higher than 0.4. When the equation value for CF₄ is lower than 0.3, it is set equal to 0.3. This will insure reasonable extrapolation beyond the limits of the study data.

Douglas-fir

$$\begin{aligned} \text{IF1/4}_{6.5} \text{ (when } H < 57 \text{ feet)} &= 1.575350 - 1269.84 \left(\frac{1}{DH}\right) \\ &+ 20.4816 \left(\frac{1}{D}\right) + 0.0000135387 H^2 \\ &+ 7333.86 \left(\frac{1}{D^2H}\right) - 128.342 \left(\frac{1}{D^2}\right) \\ SF_u &= 2.58530 - 83.5000 \left(\frac{1}{H}\right) \end{aligned}$$

Ponderosa and
Jeffrey pine

$$\begin{aligned} CF_4 &= 0.402060 - 0.899914 \left(\frac{1}{D}\right) \\ \text{IF1/4}_{6.5} &= 3.02027 - 22.0313 \left(\frac{1}{D}\right) + 0.00201362 (H) \\ SF_u^{5/} &= 3.22940 - 585.500 \left(\frac{1}{DH}\right) - 21.7575 \left(\frac{1}{D}\right) \end{aligned}$$

Sugar pine

$$\begin{aligned} CF_4 &= 0.358550 - 0.488134 \left(\frac{1}{D}\right) \\ \text{IF1/4}_{6.5} &= 2.75889 - 18.1229 \left(\frac{1}{D}\right) + 0.000225065 \left(\frac{H^2}{D}\right) \\ SF_u &= 2.88706 - 25.2838 \left(\frac{1}{D}\right) \end{aligned}$$

Lodgepole pine

$$\begin{aligned} CF_4 &= 0.422709 - 0.0000612236 \left(\frac{H^2}{D}\right) \\ \text{IF1/4}_{6.5} &= 2.86258 - 716.659 \left(\frac{1}{DH}\right) \\ SF_u &= 2.63048 - 850.630 \left(\frac{1}{DH}\right) \end{aligned}$$

White fir

$$\begin{aligned} CF_4 &= 0.299039 - 1.91272 \left(\frac{1}{H}\right) + 0.000367217 \left(\frac{H^2}{D}\right) \\ \text{IF1/4}_{6.5} \text{ (when } D \geq 11.0 \text{ inches)} &= 2.08637 - 119.839 \left(\frac{1}{D^2}\right) \\ &+ 0.000620285 \left(\frac{H^2}{D}\right) \\ \text{IF1/4}_{6.5} \text{ (when } D < 11.0 \text{ inches)} &= (0.45 + 0.05 D) (1.09597 \\ &+ 0.000056389 H^2) \\ SF_u &= 2.31733 - 16.9592 \left(\frac{1}{D}\right) + 0.000548156 \left(\frac{H^2}{D}\right) \end{aligned}$$

^{5/} SF_u will be set equal to 0.7 whenever it drops below this value to insure reasonable extrapolation from small trees. The volume of a tree with a minimum saw log diameter of 8 inches/inside bark by 12 feet long is 23 board feet.

California
red fir

$$CF_4 = 0.231237 + 0.028176 \left(\frac{H}{D}\right)$$

$$IF1/4_{6.5} = 1.54320 + 0.00133466 \left(\frac{H^2}{D}\right)$$

$$SF_u = 1.59669 - 464.752 \left(\frac{1}{DH}\right) + 0.00105105 \left(\frac{H^2}{D}\right)$$

Incense-cedar

$$CF_4^{6/} = 0.225786 + 4.44236 \left(\frac{1}{H}\right)$$

$$IF1/4_{6.5} = 1.39269 + 0.0000259631 H^2$$

$$SF_u = 1.82080 - 11.7184 \left(\frac{1}{D}\right)$$

Volumes calculated from these equations are in tables 1-21.

RELIABILITY OF THE EQUATIONS

One measure of the reliability of an equation is the extent to which the individual observations deviate from the regression surfaces. A measure of this residual variation is the root mean squared error--the square root of the mean squared difference between the predicted and actual values. Table 22 shows the root mean squared error of each form factor equation, expressed both in absolute terms and as a percent of the average form factor.

It is generally desirable to test new equations against an independent source of data--data not used in the construction of the equations. We tested the equations on 441 trees from the Stanislaus National Forest which had been measured with an optical dendrometer. The results of this test, together with the results of a test of the old Forest Survey local volume tables, appear in table 23. Figures 2-9 illustrate the relationship between estimated and actual volume of the test trees. As expected, the new equations, based on d.b.h. and total height, account for more of the variation in individual tree volume than do the old tables based on d.b.h. alone. The old lodgepole pine and incense-cedar tables gave very biased estimates of tree volume in this test. Tests against different trees in other geographic areas might well produce different biases. However, the new equations, which reflect differences in individual tree heights, should carry less risk of bias than the old tables, which rely on assumptions about the average relationships between heights and d.b.h. within a site class.

We also developed a complete set of volume equations which used Girard form class as one of the independent variables. When individual tree, Girard form class is known without error, these equations are more precise than the ones presented here. In practice, however, actual form class is seldom known. A common procedure is to use average form classes by species and sometimes by diameter class. We wondered whether the addition of form class would improve the estimate of individual tree volume when average form class was substituted for actual form class.

^{6/} When the equation value for CF_4 is < 0.27 , it is set equal to 0.27 to insure reasonable extrapolation.

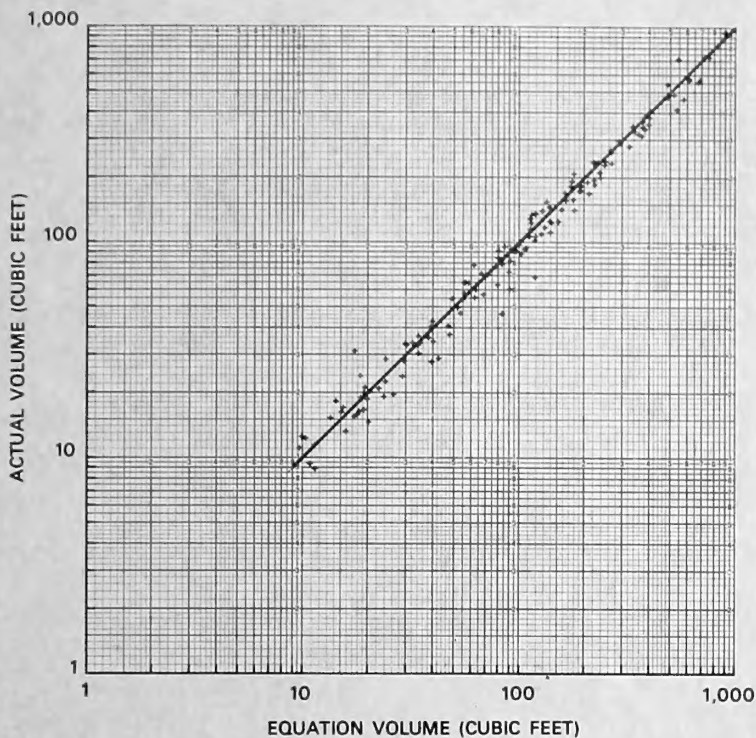


Figure 2.--Relationship between the measured cubic-foot volume of 146 ponderosa and Jeffrey pine trees and estimates from the new equation.

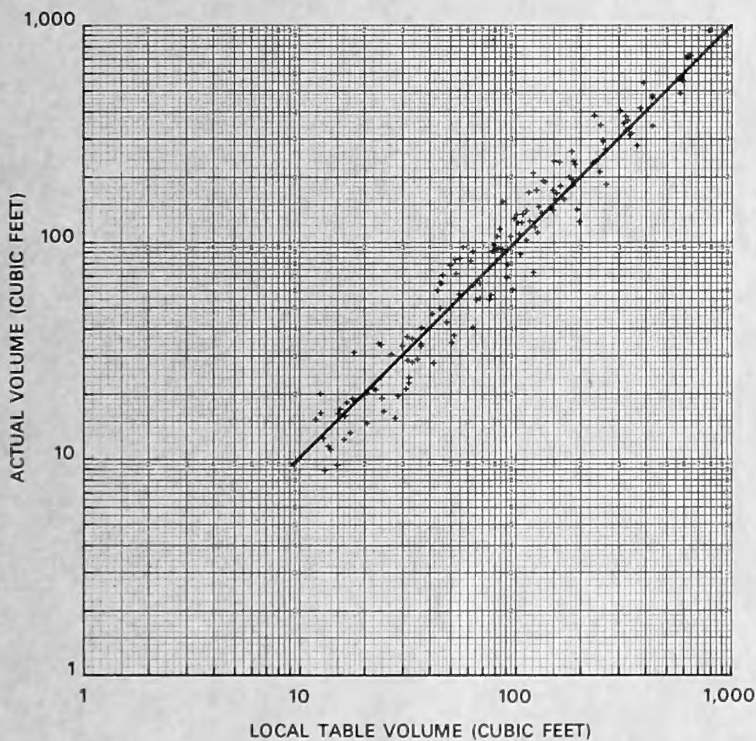


Figure 3.--Relationship between the measured cubic-foot volume of 146 ponderosa and Jeffrey pine trees and estimates from Forest Survey local volume tables.

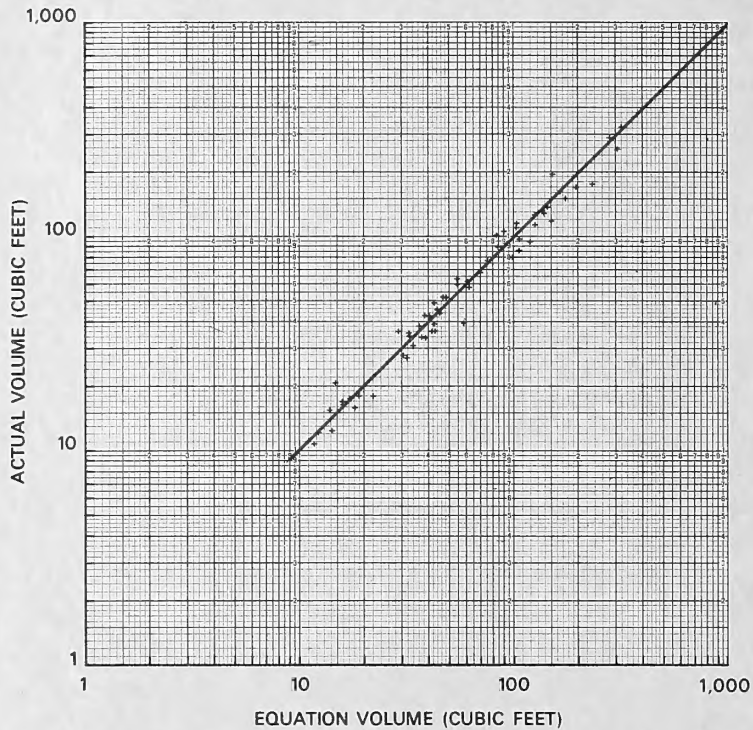


Figure 4.--Relationship between the measured cubic-foot volume of 60 lodgepole pine trees and estimated volume from the new equation.

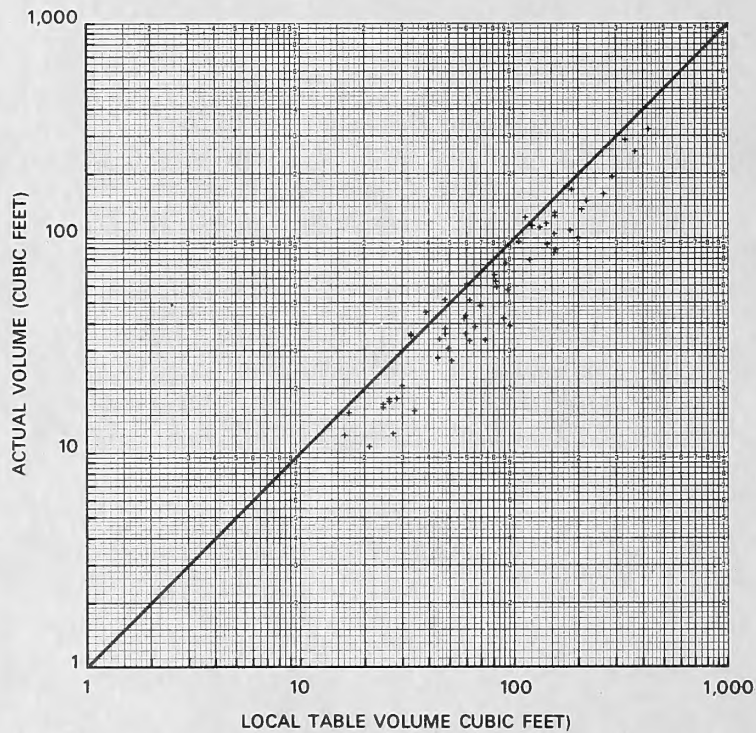


Figure 5.--Relationship between the measured cubic-foot volume of 60 lodgepole pine trees and estimates from the Forest Survey local volume tables.

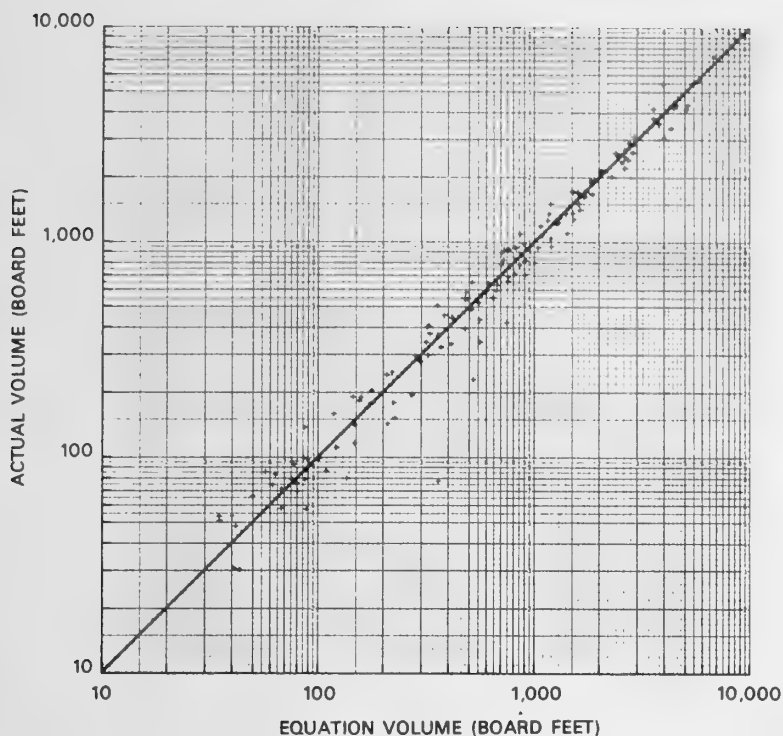


Figure 6.--Relationship between the measured International 1/4-inch board-foot volume of 146 ponderosa and Jeffrey pine trees and estimates from the new equation.

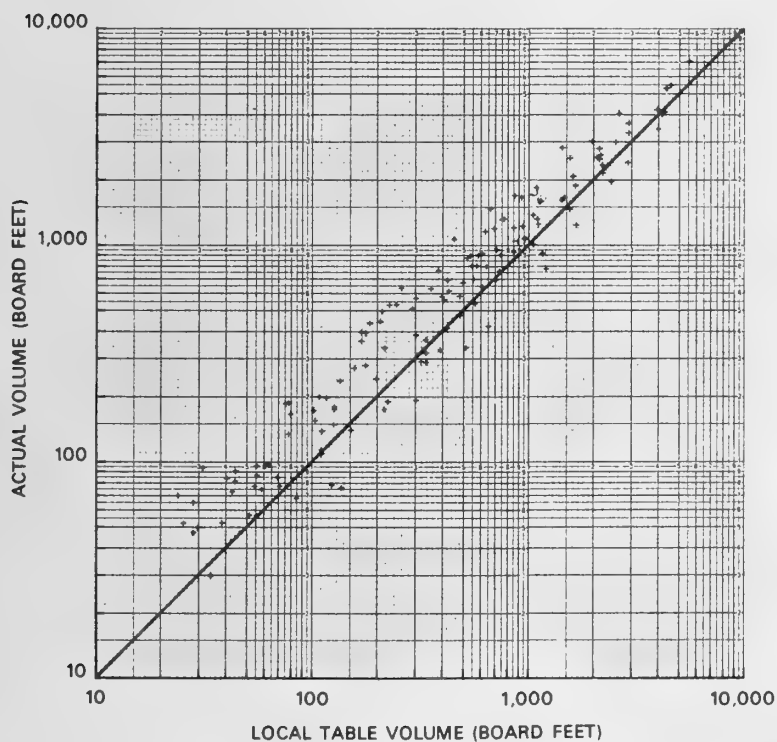


Figure 7.--Relationship between the measured International 1/4-inch board-foot volume of 146 ponderosa and Jeffrey pine trees and estimates from the Forest Survey local volume tables.

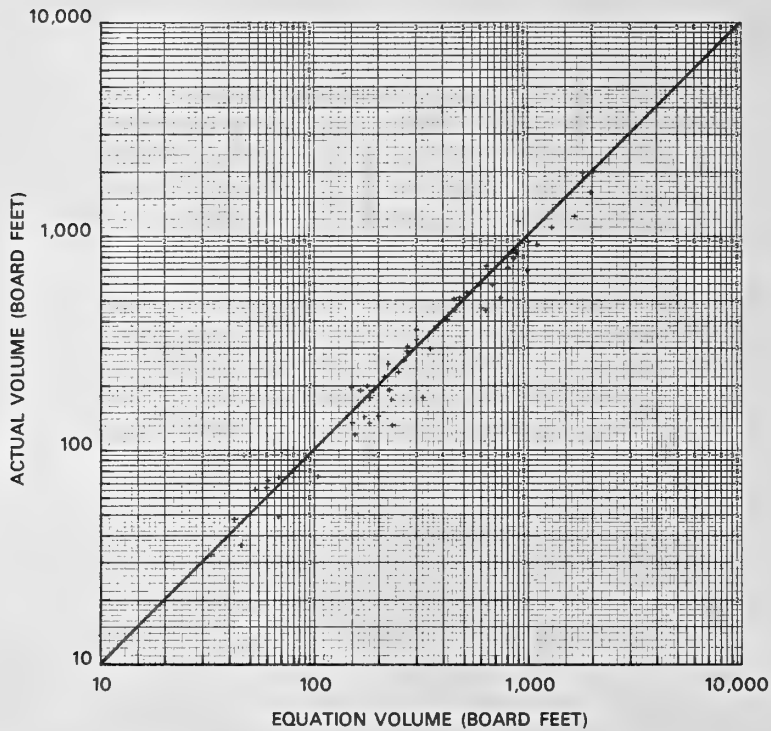


Figure 8.--Relationship between the measured International 1/4-inch board-foot volume of 60 lodgepole pine trees and estimates from the new equation.

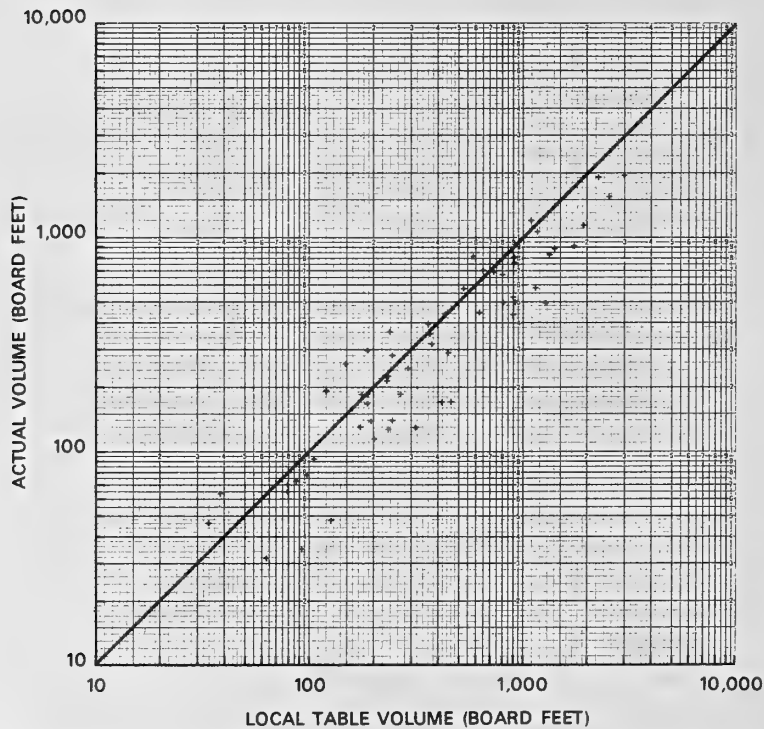


Figure 9.--Relationship between the measured International 1/4-inch board-foot volume of 60 lodgepole pine trees and estimates from the Forest Survey local volume tables.

To answer this question, we tested equations with and without form class against our 441 Stanislaus National Forest trees. The results of this test are in table 24. In this test, the extra precision gained by adding a form class variable was lost completely when average form class was substituted for actual form class, even though the actual average form classes of the test trees were used. We therefore decided not to include the form class equations in this note. We will be glad to supply the form class equations on request. However, we do not recommend their use unless form class is known for every tree.

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Table 1.—Cubic-foot volume of Douglas-fir

Top diameter, 4 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches		Total height--Feet																					
		40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	
6	3		4	5	5	6	7	8	9	9	10	11	12	13									
8	5	7	8	10	11	13	20	22	14	15	17	18	20	21	22								
10	7	10	12	15	17	20	28	31	35	38	41	44	47	50	55								
12	10	13	17	21	24	28	36	42	47	51	56	60	64	68	75								
14	13	18	22	27	31	36	46	52	58	65	72	78	84	89	100								
16	17	22	28	33	39	46	56	63	71	79	87	95	103	111	125								
18	21	27	34	41	48	56	67	76	85	94	104	113	123	133	142	152	161						
20	26	33	41	49	58	67	79	89	100	111	122	133	144	155	166	177	188						
22	32	40	49	59	69	79	92	104	116	129	141	154	167	180	193	205	218						
24	38	47	57	68	80	92	106	120	134	148	162	177	192	206	221	235	249						
26	44	55	66	79	92	106	121	136	152	169	185	201	218	234	251	267	283						
28	50	64	77	90	105	121	137	154	172	190	209	227	245	264	282	301	319						
30	56	74	88	103	119	137	154	173	193	213	234	254	275	295	316	336	356						
32	62	84	101	117	134	154	173	193	215	238	260	283	306	329	351	374	396						
34	68	91	109	127	145	165	185	206	229	254	280	308	336	364	389	413	438						
36	74	98	117	136	156	177	198	220	244	270	298	326	354	382	409	438	463						
38	80	106	126	146	167	188	210	233	258	284	312	340	368	396	424	453	482						
40	86	114	135	156	177	199	222	246	271	297	325	353	381	409	438	467	496						
42	92	122	144	166	188	211	235	260	286	312	340	368	396	424	453	482	511						
44	98	130	153	176	199	222	248	274	300	327	355	383	411	439	467	496	525						
46	104	138	162	186	210	233	260	287	314	341	369	397	425	453	481	510	538						
48	110	146	171	196	220	243	271	299	326	353	381	409	437	465	493	521	549						
50	116	154	180	205	229	252	280	308	335	362	390	418	446	474	502	530	558						
52	122	162	188	213	237	260	288	316	343	370	398	426	454	482	510	538	566						
54	128	170	196	221	244	267	295	323	350	377	405	433	461	489	517	545	573						
56	134	178	204	229	252	275	303	331	358	385	413	441	469	497	525	553	581						
58	140	186	212	237	260	283	311	339	366	393	421	449	477	505	533	561	589						
60	146	194	220	245	268	291	319	347	374	402	430	458	486	514	542	570	598						
62	152	202	228	253	276	299	327	355	383	411	439	467	495	523	551	579	607						
64	158	210	236	261	284	307	335	363	391	419	447	475	503	531	559	587	615						
66	164	218	244	269	292	315	343	371	399	427	455	483	511	539	567	595	623						
68	170	226	252	277	299	322	350	378	406	434	462	490	518	546	574	602	630						
70	176	234	260	285	307	330	358	386	414	442	470	498	526	554	582	610	638						
72	182	242	268	293	315	338	366	394	422	450	478	506	534	562	590	618	646						
74	188	250	276	301	323	346	374	402	430	458	486	514	542	570	598	626	654						
76	194	258	284	309	331	354	382	410	438	466	494	522	550	578	606	634	662						
78	200	266	292	317	339	362	390	418	446	474	502	530	558	586	614	642	670						
80	206	274	300	325	347	370	398	426	454	482	510	538	566	594	622	650	678						

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 2.—Board-foot volume of Douglas-fir by International 1/4-inch rule

Top diameter, 6.5 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches//	Total height--Feet																			Top diameter, 6.5 inches Stump height, 1 foot			
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240		
10	22	35	51	72	93	114	136	158	181	204	228	252	277										
12	33	52	74	101	129	157	185	215	245	275	307	339	373										
14	46	72	101	135	170	206	242	280	318	357	397	439	482										
16	62	96	132	175	218	262	307	353	400	449	499	551	605										
18	81	123	168	219	271	324	379	435	492	551	612	675	740										
20	102	154	208	269	330	393	458	525	593	664	736	812	890	971	1,055	1,142							
22	127	188	252	323	395	469	545	623	703	786	872	961	1,053	1,148	1,247	1,350							
24	154	226	301	382	466	551	639	730	823	919	1,019	1,122	1,229	1,340	1,455	1,575							
26	184	267	353	447	543	640	741	845	952	1,062	1,177	1,295	1,418	1,546	1,679	1,818							
28		312	410	516	625	736	850	968	1,090	1,216	1,346	1,481	1,621	1,767	1,919	2,077							
30		360	472	591	713	838	967	1,100	1,237	1,379	1,526	1,679	1,838	2,003	2,175	2,354							
32		411	537	670	807	947	1,091	1,240	1,394	1,553	1,718	1,890	2,068	2,253	2,447	2,648							
34			607	755	907	1,063	1,223	1,389	1,560	1,737	1,921	2,112	2,311	2,518	2,734	2,959							
36			681	844	1,012	1,185	1,362	1,545	1,735	1,931	2,135	2,347	2,568	2,798	3,037	3,287							
38				939	1,124	1,313	1,509	1,710	1,919	2,136	2,361	2,595	2,838	3,092	3,356	3,632							
40				1,039	1,241	1,449	1,663	1,884	2,113	2,351	2,597	2,854	3,121	3,400	3,691	3,994							
42				1,143	1,364	1,590	1,824	2,066	2,316	2,576	2,845	3,126	3,418	3,723	4,041	4,374							
44				1,253	1,492	1,739	1,993	2,256	2,528	2,811	3,105	3,410	3,729	4,061	4,408	4,770							
46				1,367	1,627	1,894	2,170	2,455	2,750	3,056	3,375	3,707	4,053	4,413	4,790	5,184							
48				1,487	1,767	2,056	2,354	2,661	2,981	3,312	3,657	4,016	4,390	4,780	5,188	5,615							
50				1,612	1,914	2,224	2,545	2,877	3,221	3,578	3,950	4,337	4,740	5,162	5,602	6,062							
52					2,399	2,744	3,100	3,470	3,854	4,254	4,670	5,104	5,558	6,032	6,527	7,046							
54					2,581	2,950	3,332	3,729	4,140	4,569	5,016	5,482	5,969	6,477	7,009	7,566							
56					2,769	3,164	3,572	3,996	4,437	4,896	5,374	5,873	6,394	6,934	7,499	8,085							
58					2,964	3,385	3,821	4,274	4,744	5,234	5,744	6,277	6,834	7,416	8,025	8,662							
60					3,165	3,614	4,078	4,560	5,061	5,583	6,127	6,695	7,288	7,909	8,558	9,238							
62						4,856	5,388	5,943	6,522	7,126	7,757	8,418	9,109	9,832	10,590	11,383							
64						5,161	5,726	6,315	6,929	7,571	8,241	8,942	9,676	10,445	11,250	12,093							
66						5,475	6,074	6,698	7,349	8,028	8,739	9,483	10,261	11,076	11,930	12,824							
68						5,798	6,432	7,092	7,780	8,500	9,252	10,039	10,863	11,726	12,630	13,577							
70						6,131	6,800	7,497	8,225	8,985	9,779	10,611	11,482	12,394	13,350	14,351							
72							7,914	8,681	9,483	10,321	11,199	12,118	13,081	14,089	15,146	16,253							
74							8,341	9,150	9,995	10,878	11,803	12,771	13,786	14,849	15,963	17,130							
76							8,781	9,631	10,520	11,449	12,422	13,442	14,509	15,628	16,801	18,030							
78							9,231	10,124	11,058	12,035	13,058	14,129	15,251	16,428	17,661	18,953							
80							9,692	10,630	11,610	12,635	13,709	14,834	16,012	17,247	18,542	19,899							

// Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 3.—Board-foot volume of Douglas-fir by Scribner rule in 16-foot logs to a utilized top

Stump and top excluded		Total height--Feet																					Top diameter, variable Stump height, 1 foot	
		Diameter breast height outside bark-- inches.1/	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230		
12	2 1/2	36	56	77	97	117	137	158	178	198	219	239	259											
14	23	49	77	104	132	159	187	215	242	270	298	325	353											
16	28	64	100	136	172	208	244	280	317	353	389	425	461											
18	35	81	127	172	218	264	309	355	401	446	492	538	583											
20	43	100	156	213	269	325	382	438	495	551	607	664	720	777	833	889								
22	53	121	189	257	326	394	462	530	599	667	735	803	872	940	1,008	1,076								
24	63	144	225	306	387	469	550	631	712	794	875	956	1,037	1,118	1,200	1,281								
26	73	169	264	359	455	550	645	741	836	931	1,027	1,122	1,217	1,313	1,408	1,503								
28	83	196	306	417	527	638	748	859	970	1,080	1,191	1,301	1,412	1,522	1,633	1,743								
30	93	225	352	478	605	732	859	986	1,113	1,240	1,367	1,494	1,621	1,748	1,874	2,001								
32	103	256	400	544	689	833	978	1,122	1,266	1,411	1,555	1,700	1,844	1,988	2,133	2,277								
34	113	286	452	615	778	941	1,104	1,267	1,430	1,593	1,756	1,919	2,082	2,245	2,408	2,571								
36	123	316	506	699	892	1,085	1,278	1,471	1,664	1,857	2,050	2,243	2,436	2,629	2,822	3,015								
38	133	346	566	789	1,012	1,235	1,458	1,681	1,904	2,127	2,350	2,573	2,796	3,019	3,242	3,465								
40	143	376	616	869	1,132	1,395	1,658	1,921	2,184	2,447	2,710	2,973	3,236	3,499	3,762	4,025								
42	153	406	689	972	1,265	1,578	1,891	2,204	2,517	2,830	3,143	3,456	3,769	4,082	4,395	4,708								
44	163	436	769	1,085	1,418	1,781	2,144	2,507	2,870	3,233	3,596	3,959	4,322	4,685	5,048	5,411								
46	173	466	849	1,198	1,561	1,964	2,367	2,770	3,173	3,576	3,979	4,382	4,785	5,188	5,591	5,994								
48	183	496	929	1,311	1,704	2,147	2,590	3,033	3,476	3,919	4,362	4,805	5,248	5,691	6,134	6,577								
50	193	526	1,009	1,434	1,877	2,370	2,863	3,356	3,849	4,342	4,835	5,328	5,821	6,314	6,807	7,300								
52	203	556	1,089	1,554	2,027	2,560	3,093	3,626	4,159	4,692	5,225	5,758	6,291	6,824	7,357	7,890								
54	213	586	1,169	1,674	2,210	2,793	3,376	3,959	4,542	5,125	5,708	6,291	6,874	7,457	8,040	8,623								
56	223	616	1,249	1,794	2,410	3,033	3,656	4,279	4,902	5,525	6,148	6,771	7,394	8,017	8,640	9,263								
58	233	646	1,329	1,914	2,557	3,216	3,839	4,462	5,085	5,708	6,331	6,954	7,577	8,200	8,823	9,446								
60	243	676	1,409	2,034	2,700	3,353	4,006	4,649	5,292	5,935	6,578	7,221	7,864	8,507	9,150	9,793								
62	253	706	1,489	2,154	2,849	3,532	4,211	4,890	5,569	6,248	6,927	7,606	8,285	8,964	9,643	10,322								
64	263	736	1,569	2,274	3,004	3,713	4,422	5,131	5,840	6,549	7,258	7,967	8,676	9,385	10,094	10,803								
66	273	766	1,649	2,394	3,159	3,908	4,657	5,406	6,155	6,904	7,653	8,402	9,151	9,900	10,649	11,398								
68	283	796	1,729	2,514	3,314	4,103	4,902	5,701	6,500	7,299	8,098	8,897	9,696	10,495	11,294	12,093								
70	293	826	1,809	2,634	3,479	4,312	5,141	5,970	6,800	7,629	8,458	9,287	10,116	10,945	11,774	12,603								
72	303	856	1,889	2,754	3,644	4,531	5,400	6,269	7,138	8,007	8,876	9,745	10,614	11,483	12,352	13,221								
74	313	886	1,969	2,874	3,809	4,750	5,679	6,608	7,537	8,466	9,395	10,324	11,253	12,182	13,111	14,040								
76	323	916	2,049	3,029	4,010	5,001	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000								
78	333	946	2,129	3,149	4,181	5,222	6,273	7,324	8,375	9,426	10,477	11,528	12,579	13,630	14,681	15,732								
80	343	976	2,209	3,269	4,322	5,393	6,474	7,555	8,636	9,717	10,798	11,879	12,960	14,041	15,122	16,203								

1/ Diameter classes are midpoint; e.g. 12-inch class includes 11.0-12.9.

NOTE.--Block indicates extent of data.

2/ The volume of a tree with a minimum saw log 8 inches d.i.b. and 12 feet long is 23 board feet. Trees lacking this minimum saw log have no Scribner volume.

Table 4.—Cubic-foot volume of ponderosa and Jeffrey pine

Top diameter, 4 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- Inches		Total height--Feet																			Top diameter, 4 inches Stump height, 1 foot	
40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240		
6	2	3	4	5	5	6	6	7	8	8	9	9										
8	4	5	6	7	8	9	10	12	14	15	16	17										
10	7	9	10	12	14	15	17	19	20	22	24	26	27									
12	10	13	15	18	21	23	26	28	31	33	36	39	41									
14	14	18	22	25	29	32	36	40	43	47	51	54	58									
16	19	24	29	34	39	43	48	53	58	63	68	72	77									
18	25	31	37	44	50	56	62	68	75	81	87	93	100									
20	31	39	47	55	62	70	78	86	93	101	109	117	125	140	148							
22	38	48	57	67	76	86	95	105	114	124	133	143	153	162	172	181						
24	46	57	69	80	92	103	115	126	137	149	160	172	183	195	206	218						
26	54	68	81	95	108	122	135	149	163	176	190	203	217	230	244	257						
28	79	95	111	127	142	158	174	190	206	221	237	253	269	285	301	317	334	350	365	384	402	438
30	91	110	128	146	164	183	201	219	237	256	274	292	310	329	347	365	383	401	419	437	455	501
32	104	125	146	167	188	209	230	251	272	292	313	334	355	376	397	418	439	459	480	501	521	568
34		142	166	189	213	237	260	284	308	332	355	379	403	426	450	474	497	521	545	568	591	640
36		160		187	213	240	267	293	320	346	373	400	426	453	480	506	533	560	586	613	640	685
38			209	238	268	298	328	358	387	417	447	477	507	536	566	596	626	656	685	715	745	795
40			232	265	298	331	364	397	431	464	497	530	563	596	629	662	696	729	762	795	828	879
42			256	293	330	366	403	439	476	513	549	586	623	659	696	732	769	806	842	879	916	967
44			282	322	363	403	443	484	524	564	604	645	685	725	766	806	846	887	927	967	1,007	1,059
46			309	353	397	441	486	530	574	618	662	706	750	795	839	883	927	971	1,015	1,059	1,103	1,156
48			337	385	434	482	530	578	626	674	723	771	819	867	915	963	1,012	1,060	1,108	1,156	1,204	1,257
50			367	419	471	524	576	628	681	733	786	838	890	943	995	1,047	1,100	1,152	1,204	1,257	1,310	1,362
52			511	567	624	681	736	792	848	904	960	1,016	1,072	1,128	1,184	1,240	1,296	1,352	1,408	1,464	1,520	1,576
54			552	613	674	736	792	848	904	960	1,016	1,072	1,128	1,184	1,240	1,296	1,352	1,408	1,464	1,520	1,576	1,632
56			594	660	726	786	848	904	960	1,016	1,072	1,128	1,184	1,240	1,296	1,352	1,408	1,464	1,520	1,576	1,632	1,688
58			638	709	780	848	904	960	1,016	1,072	1,128	1,184	1,240	1,296	1,352	1,408	1,464	1,520	1,576	1,632	1,688	1,744
60			684	760	836	912	975	1,040	1,104	1,168	1,232	1,296	1,360	1,424	1,488	1,552	1,616	1,680	1,744	1,808	1,872	1,936
62							1,040	1,104	1,168	1,232	1,296	1,360	1,424	1,488	1,552	1,616	1,680	1,744	1,808	1,872	1,936	1,999
64							1,107	1,171	1,235	1,299	1,363	1,427	1,491	1,555	1,619	1,683	1,747	1,811	1,875	1,939	2,003	2,067
66							1,177	1,241	1,305	1,369	1,433	1,497	1,561	1,625	1,689	1,753	1,817	1,881	1,945	2,009	2,073	2,137
68							1,248	1,312	1,376	1,440	1,504	1,568	1,632	1,696	1,760	1,824	1,888	1,952	2,016	2,080	2,144	2,208
70																						
72																						
74																						
76																						
78																						
80																						

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.

NOTE.--Block indicates extent of data.

Table 5.—Board-foot volume of ponderosa and Jeffrey pine by International 1/4-inch rule

Top diameter, 6.5 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches ^{1/}	Total height--Feet																					
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	
10	20	25	31	37	43	49	56	62	69	76	84	92	99									
12	40	50	62	73	85	97	109	121	134	148	161	175	189									
14	65	83	101	119	137	157	176	196	217	237	259	280	303									
16	96	122	148	174	202	229	258	286	316	346	376	407	439									
18	133	168	203	240	277	315	353	392	432	473	514	556	599									
20	174	220	267	315	363	412	463	514	566	618	672	727	782	839	896	954						
22	222	280	339	399	460	523	586	651	716	783	850	919	989	1,060	1,132	1,204						
24	274	346	419	493	569	646	724	803	884	966	1,049	1,133	1,219	1,306	1,394	1,483						
26	332	419	507	597	688	781	875	971	1,068	1,167	1,267	1,369	1,472	1,577	1,683	1,790						
28	499	604	711	819	929	1,090	1,221	1,354	1,489	1,626	1,765	1,906	2,048	2,193	2,340	2,489	2,640	2,792	2,947	3,104	3,262	
30	586	709	834	961	1,090	1,263	1,415	1,569	1,725	1,883	2,044	2,207	2,372	2,539	2,709	2,880	3,054	3,231	3,409	3,590	3,773	
32	679	822	967	1,114	1,263	1,449	1,623	1,799	1,978	2,159	2,343	2,529	2,718	2,910	3,104	3,300	3,499	3,701	3,905	4,112	4,321	
34		943	1,109	1,278	1,449	1,647	1,845	2,045	2,248	2,454	2,662	2,874	3,088	3,305	3,525	3,748	3,974	4,203	4,434	4,668	4,905	
36		1,073	1,261	1,453	1,647	1,858	2,081	2,306	2,535	2,767	3,002	3,240	3,481	3,726	3,974	4,224	4,479	4,736	4,996	5,260	5,526	
38		1,423	1,639	1,858	2,082	2,331	2,583	2,839	3,099	3,361	3,628	3,898	4,171	4,448	4,729	5,013	5,301	5,592	5,886	6,184	6,484	
40		1,595	1,836	2,082	2,331	2,583	2,839	3,099	3,361	3,628	3,898	4,171	4,448	4,729	5,013	5,301	5,592	5,886	6,184	6,484	6,789	
42		1,776	2,045	2,318	2,595	2,876	3,160	3,449	3,741	4,038	4,338	4,642	4,950	5,262	5,577	5,897	6,220	6,548	6,879	7,210	7,548	
44		1,967	2,264	2,567	2,873	3,184	3,499	3,818	4,141	4,469	4,801	5,137	5,478	5,822	6,171	6,525	6,882	7,244	7,610	7,975	8,348	
46		2,167	2,495	2,828	3,165	3,507	3,854	4,206	4,562	4,922	5,288	5,658	6,032	6,412	6,795	7,184	7,577	7,975	8,378	8,781	9,184	
48		2,377	2,737	3,102	3,472	3,847	4,227	4,612	5,002	5,397	5,798	6,203	6,613	7,029	7,449	7,875	8,306	8,741	9,182	9,623	10,064	
50		2,597	2,990	3,388	3,792	4,201	4,616	5,037	5,463	5,894	6,331	6,773	7,221	7,674	8,133	8,597	9,067	9,543	10,023	10,503	10,984	
52			3,687	4,126	4,572	5,023	5,480	5,943	6,412	6,887	7,368	7,855	8,348	8,847	9,352	9,862	10,379	10,901	11,423	11,945	12,467	
54			3,999	4,475	4,958	5,447	5,942	6,444	6,953	7,467	7,988	8,516	9,050	9,590	10,137	10,690	11,250	11,816	12,382	12,948	13,514	
56			4,323	4,837	5,359	5,888	6,423	6,965	7,514	8,071	8,634	9,203	9,780	10,364	10,954	11,552	12,156	12,767	13,378	13,989	14,600	
58			4,659	5,214	5,776	6,346	6,922	7,507	8,098	8,697	9,304	9,917	10,538	11,167	11,803	12,446	13,097	13,755	14,413	15,071	15,729	
60			5,009	5,605	6,209	6,821	7,440	8,068	8,704	9,347	9,998	10,658	11,325	12,000	12,683	13,374	14,073	14,780	15,487	16,194	16,901	
62				7,313	7,977	8,650	9,331	10,020	10,718	11,425	12,140	12,863	13,595	14,335	15,084	15,841	16,600	17,359	18,118	18,877	19,636	
64				7,822	8,532	9,251	9,980	10,717	11,463	12,218	12,983	13,756	14,538	15,330	16,130	16,939	17,749	18,558	19,367	20,176	20,985	
66				8,348	9,106	9,873	10,650	11,437	12,233	13,039	13,854	14,679	15,513	16,357	17,211	18,074	18,937	19,800	20,663	21,526	22,389	
68				8,891	9,698	10,515	11,343	12,180	13,028	13,885	14,753	15,631	16,520	17,418	18,326	19,245	20,164	21,083	22,002	22,921	23,840	
70				9,452	10,309	11,178	12,057	12,947	13,847	14,759	15,681	16,614	17,558	18,512	19,477	20,453	21,429	22,405	23,381	24,357	25,333	
72					11,860	12,793	13,737	14,692	15,659	16,637	17,626	18,627	19,639	20,663	21,698	22,733	23,768	24,803	25,838	26,873	27,908	
74					12,563	13,550	14,550	15,561	16,585	17,621	18,668	19,728	20,800	21,884	22,980	24,076	25,172	26,268	27,364	28,460	29,556	
76					13,286	14,330	15,386	16,456	17,538	18,633	19,741	20,861	21,994	23,139	24,298	25,457	26,616	27,775	28,934	30,093	31,252	
78					14,029	15,131	16,246	17,375	18,518	19,673	20,843	22,025	23,221	24,430	25,653	26,876	28,100	29,323	30,546	31,769	32,992	
80					14,792	15,954	17,130	18,320	19,524	20,742	21,974	23,221	24,481	25,756	27,044	28,332	29,620	30,908	32,196	33,484	34,772	

^{1/} Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.—Block indicates extent of data.

Table 6.—Board-foot volume of ponderosa and Jeffrey pine by Scribner rule in 16-foot logs to a utilized top

Stump and top excluded		Total height--Feet																					Top diameter, variable Stump height, 1 foot	
Diameter breast height outside bark-- Inches ^{1/}		40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240		
12	27	23	33	40	51	62	73	84	95	106	117	129	140											
14	30	45	63	81	99	116	134	152	170	188	206	224	242											
16	53	79	106	132	158	184	210	236	262	288	314	340	367											
18	85	121	157	192	228	264	300	335	371	407	442	478	514											
20	123	170	216	263	310	357	403	450	497	544	590	637	684											
22	166	225	285	344	403	462	521	580	639	699	758	817	876											
24	215	288	361	434	507	580	653	726	799	872	945	1,018	1,091											
26	270	358	446	534	623	711	799	887	976	1,064	1,152	1,240	1,328											
28	340	435	540	645	749	854	959	1,064	1,169	1,274	1,379	1,484	1,588											
30	420	519	642	765	888	1,010	1,133	1,256	1,379	1,502	1,625	1,748	1,871											
32	510	610	752	895	1,037	1,179	1,322	1,464	1,606	1,749	1,891	2,034	2,176											
34	610	871	1,034	1,198	1,361	1,524	1,687	1,851	2,014	2,177	2,340	2,504	2,667											
36	998	1,184	1,369	1,553	1,741	1,926	2,112	2,297	2,483	2,668	2,854	3,039	3,227											
38	1,343	1,553	1,762	1,971	2,180	2,390	2,599	2,808	3,017	3,227	3,436	3,645	3,854											
40	1,513	1,747	1,981	2,216	2,450	2,684	2,919	3,153	3,388	3,622	3,856	4,091	4,325											
42	1,692	1,953	2,214	2,475	2,735	2,996	3,257	3,518	3,779	4,040	4,301	4,561	4,822											
44	1,881	2,170	2,459	2,747	3,036	3,325	3,614	3,902	4,191	4,480	4,769	5,058	5,346											
46	2,080	2,398	2,716	3,034	3,352	3,671	3,989	4,307	4,625	4,943	5,261	5,579	5,897											
48	2,289	2,638	2,986	3,335	3,684	4,033	4,382	4,731	5,080	5,428	5,777	6,126	6,475											
50	2,507	2,888	3,269	3,650	4,031	4,412	4,793	5,174	5,555	5,936	6,317	6,698	7,079											
52	3,565	3,980	4,394	4,809	5,223	5,638	6,052	6,467	6,882	7,296	7,711	8,125	8,540											
54	3,873	4,323	4,772	5,222	5,671	6,121	6,571	7,020	7,470	7,919	8,369	8,818	9,268											
56	4,194	4,680	5,166	5,652	6,138	6,624	7,110	7,596	8,082	8,568	9,053	9,539	10,025											
58	4,528	5,052	5,575	6,099	6,623	7,147	7,670	8,194	8,718	9,241	9,765	10,289	10,812											
60	4,874	5,437	6,000	6,563	7,126	7,689	8,252	8,815	9,378	9,940	10,503	11,066	11,629											
62	7,044	7,647	8,251	8,854	9,458	10,061	10,665	11,268	11,872	12,475	13,079	13,682	14,286											
64	7,542	8,187	8,833	9,478	10,124	10,769	11,415	12,060	12,706	13,351	13,997	14,642	15,288											
66	8,056	8,745	9,434	10,123	10,812	11,501	12,190	12,879	13,568	14,257	14,946	15,635	16,324											
68	8,588	9,322	10,055	10,789	11,523	12,257	12,991	13,724	14,458	15,192	15,926	16,659	17,393											
70	9,136	9,916	10,696	11,476	12,256	13,036	13,816	14,596	15,376	16,156	16,936	17,716	18,496											
72	9,690	10,510	11,330	12,150	12,970	13,790	14,610	15,430	16,250	17,070	17,890	18,710	19,530											
74	10,244	11,114	11,984	12,854	13,724	14,594	15,464	16,334	17,204	18,074	18,944	19,814	20,684											
76	10,800	11,710	12,620	13,530	14,440	15,350	16,260	17,170	18,080	18,990	19,900	20,810	21,720											
78	11,356	12,316	13,276	14,236	15,196	16,156	17,116	18,076	19,036	19,996	20,956	21,916	22,876											
80	11,912	12,922	13,932	14,942	15,952	16,962	17,972	18,982	19,992	21,002	22,012	23,022	24,032											

^{1/} Diameter classes are midpoint; e.g. 12-inch class includes 11.0-12.9.

NOTE.--Block indicates extent of data.

^{2/} The volume of a tree with a minimum saw log 8 inches d.i.b. and 12 feet long is 23 board feet. Trees lacking this minimum saw log have no Scribner volume.

Table 7.—Cubic-foot volume of sugar pine

Top diameter, 4 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches--1/2		Total height--Feet																					
		40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	
6	2		3	4	4	5	5	6	6	7	8	8	9	9									
8	4		5	6	7	8	9	10	12	13	14	15	16	17									
10	7		8	10	12	14	15	17	19	20	22	24	25	27									
12	10		12	15	17	20	22	25	27	30	32	35	37	40									
14	14		17	21	24	28	31	35	38	42	45	48	52	55									
16	18		23	27	32	37	41	46	50	55	60	64	69	73									
18	23		29	35	41	47	53	59	64	70	76	82	88	94									
20	29		36	44	51	58	66	73	80	87	95	102	109	117	124	131	139						
22	36		44	53	62	71	80	89	98	107	115	124	133	142	151	160	169						
24	43		53	64	74	85	96	106	117	128	138	149	159	170	181	191	202						
26	50		63	75	88	100	113	125	138	150	163	175	188	200	213	225	238						
28			73	88	102	117	131	146	160	175	190	204	219	233	248	263	277						
30			84	101	118	134	151	168	185	202	218	235	252	269	286	302	319	336	353	370	386	403	
32			96	115	134	153	173	192	211	230	249	268	288	307	326	345	364	383	403	422	441	460	
34				130	152	174	195	217	239	260	282	304	326	347	369	391	412	434	456	477	499	521	
36				146	171	195	219	244	268	293	317	341	366	390	415	439	463	488	512	536	561	585	
38				191	218	245	272	299	327	354	381	408	436	464	490	517	544	574	604	635	665	695	
40				212	242	272	302	332	363	393	423	453	484	514	544	574	601	634	668	701	734	768	
42				234	267	300	334	367	401	434	467	501	534	567	601	634	660	697	734	770	807	844	
44				257	294	330	367	404	440	477	514	550	587	624	660	697	734	770	807	844	881	918	
46				281	321	361	402	442	482	522	562	602	642	682	723	763	803	843	883	924	964	1,004	
48				306	350	394	438	482	525	569	613	657	700	744	788	832	876	919	963	1,007	1,051	1,094	
50				333	380	428	476	523	571	618	666	713	761	808	856	904	951	999	1,046	1,094	1,141	1,184	
52					463	515	566	618	669	721	772	824	875	927	978	1,030	1,081	1,133	1,184	1,236	1,286	1,334	
54					500	556	611	667	723	778	834	889	945	1,001	1,056	1,112	1,167	1,223	1,279	1,334	1,386	1,436	
56					539	598	658	718	778	838	898	957	1,017	1,077	1,137	1,197	1,257	1,316	1,376	1,436	1,492	1,542	
58					578	642	707	771	835	899	964	1,028	1,092	1,156	1,221	1,285	1,349	1,413	1,478	1,542	1,601	1,651	
60					619	688	757	826	894	963	1,032	1,101	1,170	1,238	1,307	1,376	1,445	1,514	1,582	1,651	1,715	1,765	
62								882	956	1,029	1,103	1,176	1,250	1,323	1,397	1,470	1,544	1,617	1,691	1,765	1,835	1,882	
64								941	1,019	1,098	1,176	1,254	1,333	1,411	1,490	1,568	1,646	1,725	1,803	1,882	1,951	2,002	
66								1,001	1,085	1,168	1,251	1,335	1,418	1,506	1,595	1,684	1,772	1,861	1,950	2,038	2,127	2,212	
68								1,063	1,152	1,241	1,329	1,418	1,506	1,597	1,691	1,785	1,879	1,973	2,067	2,161	2,255	2,347	
70								1,128	1,221	1,315	1,409	1,503	1,597	1,691	1,790	1,890	1,989	2,089	2,188	2,288	2,387	2,482	
72										1,392	1,492	1,591	1,691	1,787	1,892	1,997	2,102	2,207	2,313	2,418	2,523	2,625	
74										1,472	1,577	1,682	1,787	1,886	1,997	2,108	2,219	2,330	2,440	2,551	2,662	2,769	
76										1,553	1,664	1,775	1,886	1,997	2,108	2,219	2,330	2,440	2,551	2,662	2,769	2,874	
78										1,637	1,754	1,870	1,987	2,104	2,221	2,338	2,455	2,572	2,689	2,806	2,923	3,038	
80										1,722	1,845	1,968	2,091	2,214	2,338	2,461	2,584	2,707	2,830	2,953	3,076	3,199	

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 8.—Board-foot volume of sugar pine by International 1/4-inch rule

Top diameter, 6.5 inches
Stump height, 1 foot

Stump and top excluded

Diameter at base of stump, inches	Total height--Feet																						
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240		
10	21	27	34	40	48	55	64	73	83	94	106	119	133										
12	40	51	62	74	86	99	113	127	143	160	178	197	217										
14	64	80	98	115	134	153	174	195	218	241	266	293	321										
16	92	116	140	166	192	219	247	276	306	338	372	407	444										
18	125	158	191	224	259	295	332	370	410	451	494	539	586										
20	163	205	248	291	336	382	429	477	527	579	633	689	747	808	871	936							
22	206	259	312	367	422	479	538	598	660	723	789	857	928	1,001	1,077	1,156							
24	254	318	384	451	519	588	659	732	806	883	962	1,044	1,128	1,215	1,305	1,398							
26	306	384	463	543	625	707	792	879	967	1,058	1,152	1,248	1,347	1,449	1,555	1,663							
28		456	549	644	740	838	937	1,039	1,143	1,249	1,358	1,470	1,586	1,704	1,826	1,951							
30		533	643	753	865	979	1,095	1,213	1,333	1,456	1,582	1,711	1,843	1,979	2,119	2,262	2,410	2,562	2,719	2,881	3,048		
32		617	743	871	1,000	1,131	1,264	1,399	1,537	1,678	1,822	1,969	2,120	2,275	2,433	2,596	2,763	2,935	3,112	3,294	3,482		
34		851	997	1,144	1,293	1,445	1,599	1,756	1,916	2,079	2,246	2,416	2,591	2,770	2,953	3,141	3,334	3,532	3,736	3,945			
36		966	1,131	1,298	1,467	1,638	1,813	1,990	2,170	2,353	2,541	2,732	2,927	3,127	3,332	3,542	3,757	3,978	4,205	4,437			
38		1,274	1,462	1,652	1,844	2,039	2,237	2,439	2,644	2,853	3,067	3,284	3,507	3,735	3,968	4,206	4,451	4,701	4,958				
40		1,425	1,635	1,847	2,061	2,279	2,499	2,724	2,952	3,184	3,421	3,662	3,908	4,160	4,417	4,680	4,950	5,225	5,508				
42		1,585	1,818	2,053	2,291	2,532	2,776	3,024	3,276	3,533	3,794	4,060	4,331	4,608	4,891	5,180	5,475	5,777	6,087				
44		1,753	2,010	2,270	2,532	2,798	3,067	3,340	3,618	3,900	4,186	4,478	4,776	5,079	5,389	5,705	6,027	6,357	6,694				
46		1,930	2,212	2,498	2,786	3,077	3,373	3,672	3,976	4,285	4,598	4,917	5,242	5,573	5,910	6,255	6,606	6,965	7,331				
48		2,115	2,424	2,736	3,051	3,370	3,693	4,020	4,351	4,688	5,029	5,377	5,730	6,090	6,456	6,830	7,211	7,600	7,996				
50		2,308	2,646	2,986	3,329	3,676	4,027	4,383	4,743	5,109	5,480	5,857	6,240	6,629	7,026	7,430	7,842	8,262	8,691				
52			3,246	3,619	3,995	4,376	4,762	5,152	5,548	5,949	6,357	6,771	7,192	7,620	8,056	8,500	8,953	9,414					
54			3,517	3,920	4,328	4,739	5,156	5,578	6,005	6,438	6,878	7,324	7,777	8,238	8,707	9,185	9,671	10,166					
56			3,799	4,234	4,673	5,117	5,566	6,020	6,480	6,946	7,419	7,899	8,386	8,881	9,384	9,896	10,417	10,947					
58			4,092	4,560	5,032	5,509	5,992	6,479	6,973	7,473	7,979	8,495	9,017	9,547	10,086	10,633	11,190	11,757					
60			4,395	4,898	5,404	5,916	6,433	6,956	7,485	8,020	8,563	9,113	9,671	10,237	10,812	11,397	11,991	12,596					
62				6,337	6,890	7,449	8,014	8,586	9,165	9,752	10,348	10,952	11,565	12,187	12,820	13,463							
64				6,773	7,363	7,959	8,561	9,171	9,788	10,414	11,047	11,690	12,342	13,004	13,677	14,360							
66				7,223	7,851	8,485	9,127	9,775	10,432	11,097	11,770	12,453	13,145	13,848	14,561	15,285							
68				7,687	8,355	9,029	9,710	10,399	11,096	11,801	12,516	13,239	13,973	14,718	15,473	16,240							
70				8,166	8,874	9,590	10,312	11,042	11,780	12,527	13,284	14,050	14,827	15,614	16,413	17,223							
72					10,167	10,932	11,704	12,485	13,275	14,075	14,885	15,705	16,537	17,380	18,235								
74					10,761	11,569	12,386	13,211	14,045	14,889	15,744	16,609	17,486	18,375	19,276								
76					11,372	12,225	13,086	13,957	14,836	15,726	16,627	17,538	18,462	19,397	20,346								
78					12,000	12,899	13,806	14,723	15,649	16,586	17,534	18,493	19,464	20,448	21,445								
80					12,645	13,591	14,546	15,510	16,484	17,469	18,465	19,473	20,493	21,526	22,573								

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.

NOTE.—Block indicates extent of data.

Table 9.—Board-foot volume of sugar pine in 16-foot logs to a utilized top

Stump and top excluded		Total height--Feet																				Top diameter, variable Stump height, 1 foot	
Diameter breast height outside bark-- inches ^{1/2}		40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	
12	25	31	37	43	49	55	61	67	74	80	86	92	98										
14	46	58	69	81	92	104	116	127	139	150	162	173	185										
16	73	91	109	128	146	164	182	201	219	237	255	274	292										
18	105	131	157	183	210	236	262	288	314	341	367	393	419										
20	142	177	212	248	283	319	354	389	425	460	496	531	566	602	637	673							
22	183	229	275	321	367	413	459	505	550	596	642	688	734	780	826	872							
24	230	288	346	403	461	518	576	634	691	749	806	864	922	979	1,037	1,094							
26	282	353	424	494	565	635	706	777	847	918	988	1,059	1,129	1,200	1,271	1,341							
28	424	509	594	679	764	848	933	1,018	1,103	1,188	1,273	1,357	1,442	1,527	1,612								
30	502	602	702	803	903	1,003	1,104	1,204	1,305	1,405	1,505	1,606	1,706	1,806	1,907								
32	586	703	820	937	1,054	1,171	1,288	1,405	1,522	1,640	1,757	1,874	1,991	2,108	2,225	2,342	2,459	2,577	2,694	2,811			
34	811	946	1,081	1,216	1,351	1,487	1,622	1,757	1,892	2,027	2,162	2,297	2,433	2,568	2,703	2,838	2,973	3,108	3,243	3,378	3,513		
36	927	1,081	1,235	1,390	1,544	1,699	1,853	2,008	2,162	2,316	2,471	2,625	2,780	2,934	3,089	3,243	3,397	3,552	3,706	3,861	4,015		
38	1,225	1,400	1,575	1,750	1,925	2,100	2,275	2,450	2,625	2,800	2,975	3,150	3,325	3,500	3,675	3,849	4,024	4,199	4,374	4,548	4,723		
40	1,377	1,574	1,771	1,968	2,165	2,361	2,558	2,755	2,952	3,149	3,346	3,542	3,739	3,936	4,132	4,329	4,526	4,723	4,920	5,117	5,314		
42	1,539	1,759	1,979	2,198	2,418	2,638	2,858	3,078	3,298	3,518	3,737	3,957	4,177	4,397	4,617	4,837	5,057	5,276	5,496	5,716	5,936		
44	1,709	1,953	2,198	2,442	2,686	2,930	3,174	3,418	3,663	3,907	4,151	4,395	4,639	4,883	5,128	5,372	5,616	5,860	6,104	6,348	6,592		
46	1,888	2,158	2,428	2,698	2,967	3,237	3,507	3,777	4,046	4,316	4,586	4,856	5,125	5,395	5,665	5,935	6,204	6,474	6,744	7,014	7,284		
48	2,076	2,373	2,669	2,966	3,263	3,559	3,856	4,152	4,449	4,746	5,042	5,339	5,636	5,932	6,229	6,525	6,822	7,119	7,416	7,713	8,010		
50	2,273	2,598	2,922	3,247	3,572	3,897	4,221	4,546	4,871	5,195	5,520	5,845	6,170	6,494	6,819	7,144	7,468	7,793	8,118	8,443	8,768		
52			3,187	3,541	3,895	4,249	4,603	4,957	5,311	5,665	6,019	6,373	6,727	7,082	7,436	7,790	8,144	8,498	8,852	9,206	9,560		
54			3,462	3,847	4,232	4,616	5,001	5,386	5,770	6,155	6,540	6,925	7,309	7,694	8,079	8,463	8,848	9,233	9,617	10,002	10,387		
56			3,749	4,166	4,582	4,999	5,416	5,832	6,249	6,665	7,082	7,499	7,915	8,332	8,748	9,165	9,581	9,998	10,415	10,832	11,249		
58			4,048	4,497	4,947	5,397	5,846	6,296	6,746	7,196	7,645	8,095	8,545	8,995	9,444	9,894	10,344	10,793	11,243	11,693	12,143		
60			4,357	4,841	5,325	5,810	6,294	6,778	7,262	7,746	8,230	8,714	9,199	9,683	10,167	10,651	11,135	11,619	12,103	12,587	13,071		
62				6,238	6,757	7,277	7,797	8,317	8,837	9,356	9,876	10,396	10,916	11,435	11,955	12,475							
64				6,681	7,237	7,794	8,351	8,907	9,464	10,021	10,578	11,134	11,691	12,248	12,805	13,361							
66				7,139	7,734	8,329	8,924	9,518	10,113	10,708	11,303	11,898	12,493	13,088	13,683	14,278							
68				7,612	8,246	8,881	9,515	10,149	10,784	11,418	12,053	12,687	13,321	13,956	14,591	15,224							
70				8,101	8,776	9,451	10,126	10,801	11,476	12,151	12,826	13,501	14,176	14,851	15,526	16,201							
72					10,038	10,755	11,472	12,189	12,906	13,623	14,340	15,057	15,774	16,491	17,208								
74					10,643	11,403	12,164	12,924	13,684	14,444	15,205	15,965	16,725	17,485	18,246								
76					11,266	12,071	12,875	13,680	14,485	15,290	16,094	16,899	17,704	18,508	19,313								
78					11,906	12,757	13,607	14,458	15,308	16,159	17,009	17,859	18,710	19,560	20,411								
80					12,564	13,462	14,359	15,257	16,154	17,052	17,949	18,847	19,744	20,641	21,539								

^{1/2} Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.—Block indicates extent of data.

Table 10.—Cubic-foot volume of lodgepole pine

Stump and top excluded

Top diameter, 4 inches
Stump height, 1 foot

Diameter breast height outside bark-- Inches ^{1/}	Total height--Feet												
	40	50	60	70	80	90	100	110	120	130	140	150	160
6	3	4	5	5	6	6	6						
8	6	7	8	9	10	11	12						
10	9	11	13	15	17	18	20	21	22	23	23	25	26
12	13	16	19	22	25	27	29	31	33	34	35	36	38
14	17	21	26	30	34	37	41	43	46	48	50	52	53
16	22	28	34	39	44	49	54	58	62	65	68	71	73
18	28	35	42	49	57	63	69	74	79	84	88	92	95
20	35	44	52	61	70	78	86	93	99	105	111	116	120
22	42	53	63	74	84	95	104	113	121	129	136	143	148
24	50	63	75	88	101	113	125	135	146	155	164	172	180
26	59	74	88	103	118	133	147	160	172	184	194	204	214
28		86	103	120	137	154	171	186	201	214	227	240	251
30		98	118	137	157	177	196	215	232	248	263	277	291
32		112	134	156	179	201	223	245	265	283	301	318	334
34			151	177	202	227	252	277	300	322	342	361	380
36			170	198	226	254	283	311	338	362	385	408	429
38				221	252	284	315	347	378	405	431	457	481
40				244	279	314	349	384	419	450	480	508	536
42				269	308	346	385	423	462	498	531	563	593
44				296	338	380	422	465	507	548	585	620	654
46				323	369	415	462	508	554	600	641	680	718
48				352	402	452	503	553	603	653	700	743	784
50				382	436	491	545	600	654	709	761	808	854

^{1/} Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 11.—Board-foot volume of lodgepole pine by International 1/4-inch rule

Stump and top excluded

Top diameter, 6.5 inches
Stump height, 1 foot

Diameter breast height outside bark-- inches ^{1/}	Total height--Feet												
	40	50	60	70	80	90	100	110	120	130	140	150	160
10	23	39	55	70	86	101	117						
12	43	66	88	110	133	155	178	200	223	245	268	290	313
14	68	98	129	159	190	221	251	282	312	343	374	404	435
16	97	137	177	217	257	297	337	377	417	457	497	537	577
18	132	183	233	284	334	385	436	486	537	587	638	688	739
20	172	234	297	359	421	484	546	609	671	734	796	859	921
22	216	292	367	443	519	594	670	745	821	896	972	1,048	1,123
24	266	356	446	536	626	716	805	895	985	1,075	1,165	1,255	1,345
26	321	426	532	637	743	848	954	1,059	1,165	1,270	1,376	1,482	1,587
28		503	625	747	870	992	1,115	1,237	1,359	1,482	1,604	1,727	1,849
30		585	726	866	1,007	1,147	1,288	1,428	1,569	1,709	1,850	1,990	2,131
32		674	834	994	1,154	1,314	1,474	1,634	1,793	1,953	2,113	2,273	2,433
34			950	1,131	1,311	1,491	1,672	1,852	2,033	2,213	2,394	2,574	2,755
36			1,073	1,276	1,478	1,680	1,883	2,085	2,287	2,490	2,692	2,894	3,097
38				1,430	1,655	1,881	2,106	2,331	2,557	2,782	3,008	3,233	3,459
40				1,592	1,842	2,092	2,342	2,592	2,841	3,091	3,341	3,591	3,841
42				1,764	2,039	2,315	2,590	2,865	3,141	3,416	3,692	3,967	4,242
44				1,944	2,246	2,548	2,851	3,153	3,455	3,757	4,060	4,362	4,664
46				2,133	2,463	2,794	3,124	3,454	3,785	4,115	4,445	4,776	5,106
48				2,330	2,690	3,050	3,410	3,769	4,129	4,489	4,848	5,208	5,568
50				2,537	2,927	3,317	3,708	4,098	4,488	4,879	5,269	5,659	6,050

^{1/} Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 12.—Board-foot volume of lodgepole pine by Scribner rule in 16-foot logs to a utilized top

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Diameter breast height outside bark-- inches. ^{1/}	Total height--Feet												
	40	50	60	70	80	90	100	110	120	130	140	150	160
12	27	48	68	89	110	130	151	172	192	213	234	254	275
14	48	76	104	132	160	188	216	244	272	301	329	357	385
16	73	109	146	183	220	256	293	330	367	403	440	477	513
18	102	149	195	242	288	335	381	428	474	521	567	614	660
20	137	194	252	309	366	424	481	538	596	653	711	768	825
22	176	245	315	384	453	523	592	662	731	801	870	940	1,009
24	219	302	384	467	550	632	715	798	880	963	1,046	1,128	1,211
26	267	364	461	558	655	752	849	946	1,043	1,140	1,237	1,334	1,431
28		432	545	657	770	882	995	1,107	1,220	1,332	1,445	1,557	1,670
30		506	636	765	894	1,023	1,152	1,281	1,410	1,539	1,669	1,798	1,927
32		586	733	880	1,027	1,174	1,321	1,468	1,615	1,761	1,908	2,055	2,202
34			837	1,003	1,169	1,335	1,501	1,667	1,832	1,998	2,164	2,330	2,496
36			949	1,135	1,320	1,506	1,692	1,878	2,064	2,250	2,436	2,622	2,808
38				1,274	1,481	1,688	1,895	2,103	2,310	2,517	2,724	2,931	3,138
40				1,421	1,651	1,880	2,110	2,340	2,569	2,799	3,028	3,258	3,487
42				1,577	1,830	2,083	2,336	2,589	2,842	3,095	3,348	3,601	3,854
44				1,740	2,018	2,296	2,573	2,851	3,129	3,407	3,684	3,962	4,240
46				1,912	2,215	2,519	2,822	3,126	3,430	3,733	4,037	4,340	4,644
48				2,091	2,422	2,752	3,083	3,413	3,744	4,075	4,405	4,736	5,066
50				2,279	2,637	2,996	3,355	3,713	4,072	4,431	4,789	5,148	5,507

^{1/} Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 13.—Cubic-foot volume of white fir

Top diameter, 4 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches--1/		Total height--feet																							
		40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240			
6	3	3	4	5	5	6	7	7	8	9	9	10	10												
8	5	6	7	8	10	11	12	13	14	15	16	17	19												
10	8	9	11	13	15	17	18	20	22	24	26	27	29												
12	11	14	16	19	21	24	27	29	32	34	37	39	42												
14	15	18	22	26	29	33	36	40	43	47	50	54	57												
16	19	24	29	33	38	43	47	52	56	61	65	70	74												
18	24	30	36	42	48	54	60	66	71	77	83	89	94												
20	30	38	45	52	60	67	74	81	88	95	102	109	116												
22	36	45	54	63	72	81	90	98	107	115	124	132	141												
24	43	54	65	75	86	96	107	117	127	137	147	157	167												
26	51	63	76	88	101	113	125	137	149	161	173	185	196												
28	74	88	102	117	134	150	166	183	198	214	230	246	261												
30	84	101	118	134	152	171	189	208	226	244	262	280	297												
32	96	115	134	152	171	193	214	234	255	275	296	316	336												
34	130	151	172	193	216	240	263	286	309	331	354	376	399												
36	146	169	193	216	241	267	293	318	344	369	394	419	444												
38	189	215	241	267	296	324	353	381	409	437	465	492	520												
40	209	238	267	294	326	358	389	420	451	482	512	543	573												
42	230	263	294	326	358	389	420	451	482	512	543	573	603												
44	253	288	323	358	393	427	461	495	529	562	596	629	662												
46	276	315	353	391	429	467	504	541	578	615	651	687	723												
48	301	343	385	426	467	508	549	589	629	669	709	748	787												
50	327	372	417	462	507	551	596	639	683	726	769	812	854												
52	451	500	548	596	644	692	739	785	832	878	924	970	1,015												
54	487	539	591	643	695	746	797	847	897	947	996	1,046	1,094												
56	524	580	636	692	742	794	848	901	954	1,006	1,059	1,112	1,165												
58	562	622	682	742	794	848	901	954	1,006	1,059	1,112	1,165	1,218												
60	601	666	730	794	848	901	954	1,006	1,059	1,112	1,165	1,218	1,271												
62																									
64																									
66																									
68																									
70																									
72																									
74																									
76																									
78																									
80																									

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.—Block indicates extent of data.

Table 14.—Board-foot volume of white fir by International 1/4-inch rule

Stump and top excluded		Total height--feet																					Top diameter, 6.5 inches Stump height, 1 foot	
Diameter breast height outside bark-- inches, 1/4		40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240		
10	33	38	42	45	50	57	68	84	107	137	177	226	288											
12	56	66	75	83	92	103	119	140	169	207	255	316	390											
14	84	102	116	130	144	161	182	210	245	291	349	420	507											
16	118	144	166	186	207	230	258	292	335	389	457	539	639											
18	157	193	224	253	281	311	346	388	439	502	579	673	785											
20	201	249	290	328	365	404	446	496	556	628	716	821	947		1,096	1,271	1,475							
22	251	312	365	413	460	508	559	618	687	769	867	984	1,123	1,287	1,479	1,702	1,944							
24	306	382	448	508	566	623	685	753	832	924	1,033	1,162	1,314	1,493	1,702	1,944	2,200							
26	367	459	539	612	682	751	823	901	990	1,093	1,214	1,355	1,520	1,714	1,940	2,200	2,471							
28	432	532	612	682	751	823	901	990	1,093	1,214	1,355	1,520	1,714	1,940	2,200	2,471	2,756	3,097	3,485	3,924	4,419	4,974		
30	502	612	702	772	842	912	982	1,052	1,122	1,192	1,262	1,332	1,402	1,472	1,542	1,612	1,682	1,752	1,822	1,892	1,962	2,032		
32	582	702	802	872	942	1,012	1,082	1,152	1,222	1,292	1,362	1,432	1,502	1,572	1,642	1,712	1,782	1,852	1,922	1,992	2,062	2,132		
34	672	802	902	972	1,042	1,112	1,182	1,252	1,322	1,392	1,462	1,532	1,602	1,672	1,742	1,812	1,882	1,952	2,022	2,092	2,162	2,232		
36	772	902	1,002	1,072	1,142	1,212	1,282	1,352	1,422	1,492	1,562	1,632	1,702	1,772	1,842	1,912	1,982	2,052	2,122	2,192	2,262	2,332		
38	882	1,012	1,112	1,182	1,252	1,322	1,392	1,462	1,532	1,602	1,672	1,742	1,812	1,882	1,952	2,022	2,092	2,162	2,232	2,302	2,372	2,442		
40	1,002	1,132	1,232	1,302	1,372	1,442	1,512	1,582	1,652	1,722	1,792	1,862	1,932	2,002	2,072	2,142	2,212	2,282	2,352	2,422	2,492	2,562		
42	1,132	1,262	1,362	1,432	1,502	1,572	1,642	1,712	1,782	1,852	1,922	1,992	2,062	2,132	2,202	2,272	2,342	2,412	2,482	2,552	2,622	2,692		
44	1,262	1,392	1,492	1,562	1,632	1,702	1,772	1,842	1,912	1,982	2,052	2,122	2,192	2,262	2,332	2,402	2,472	2,542	2,612	2,682	2,752	2,822		
46	1,402	1,532	1,632	1,702	1,772	1,842	1,912	1,982	2,052	2,122	2,192	2,262	2,332	2,402	2,472	2,542	2,612	2,682	2,752	2,822	2,892	2,962		
48	1,542	1,672	1,772	1,842	1,912	1,982	2,052	2,122	2,192	2,262	2,332	2,402	2,472	2,542	2,612	2,682	2,752	2,822	2,892	2,962	3,032	3,102		
50	1,682	1,812	1,912	1,982	2,052	2,122	2,192	2,262	2,332	2,402	2,472	2,542	2,612	2,682	2,752	2,822	2,892	2,962	3,032	3,102	3,172	3,242		
52	1,822	1,952	2,052	2,122	2,192	2,262	2,332	2,402	2,472	2,542	2,612	2,682	2,752	2,822	2,892	2,962	3,032	3,102	3,172	3,242	3,312	3,382		
54	1,962	2,092	2,192	2,262	2,332	2,402	2,472	2,542	2,612	2,682	2,752	2,822	2,892	2,962	3,032	3,102	3,172	3,242	3,312	3,382	3,452	3,522		
56	2,102	2,232	2,332	2,402	2,472	2,542	2,612	2,682	2,752	2,822	2,892	2,962	3,032	3,102	3,172	3,242	3,312	3,382	3,452	3,522	3,592	3,662		
58	2,242	2,372	2,472	2,542	2,612	2,682	2,752	2,822	2,892	2,962	3,032	3,102	3,172	3,242	3,312	3,382	3,452	3,522	3,592	3,662	3,732	3,802		
60	2,382	2,512	2,612	2,682	2,752	2,822	2,892	2,962	3,032	3,102	3,172	3,242	3,312	3,382	3,452	3,522	3,592	3,662	3,732	3,802	3,872	3,942		
62	2,522	2,652	2,752	2,822	2,892	2,962	3,032	3,102	3,172	3,242	3,312	3,382	3,452	3,522	3,592	3,662	3,732	3,802	3,872	3,942	4,012	4,082		
64	2,662	2,792	2,892	2,962	3,032	3,102	3,172	3,242	3,312	3,382	3,452	3,522	3,592	3,662	3,732	3,802	3,872	3,942	4,012	4,082	4,152	4,222		
66	2,802	2,932	3,032	3,102	3,172	3,242	3,312	3,382	3,452	3,522	3,592	3,662	3,732	3,802	3,872	3,942	4,012	4,082	4,152	4,222	4,292	4,362		
68	2,942	3,072	3,172	3,242	3,312	3,382	3,452	3,522	3,592	3,662	3,732	3,802	3,872	3,942	4,012	4,082	4,152	4,222	4,292	4,362	4,432	4,502		
70	3,082	3,212	3,312	3,382	3,452	3,522	3,592	3,662	3,732	3,802	3,872	3,942	4,012	4,082	4,152	4,222	4,292	4,362	4,432	4,502	4,572	4,642		
72	3,222	3,352	3,452	3,522	3,592	3,662	3,732	3,802	3,872	3,942	4,012	4,082	4,152	4,222	4,292	4,362	4,432	4,502	4,572	4,642	4,712	4,782		
74	3,362	3,492	3,592	3,662	3,732	3,802	3,872	3,942	4,012	4,082	4,152	4,222	4,292	4,362	4,432	4,502	4,572	4,642	4,712	4,782	4,852	4,922		
76	3,502	3,632	3,732	3,802	3,872	3,942	4,012	4,082	4,152	4,222	4,292	4,362	4,432	4,502	4,572	4,642	4,712	4,782	4,852	4,922	4,992	5,062		
78	3,642	3,772	3,872	3,942	4,012	4,082	4,152	4,222	4,292	4,362	4,432	4,502	4,572	4,642	4,712	4,782	4,852	4,922	4,992	5,062	5,132	5,202		
80	3,782	3,912	4,012	4,082	4,152	4,222	4,292	4,362	4,432	4,502	4,572	4,642	4,712	4,782	4,852	4,922	4,992	5,062	5,132	5,202	5,272	5,342		

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.

NOTE.--Block indicates extent of data.

Table 15.—Board-foot volume of white fir by Scribner rule in 16-foot logs to a utilized top

Top diameter, variable
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches ^{1/}	Total height---Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
12	50	53	55	58	62	68	79	96	119	151	192	243	307								
14	77	85	92	99	108	119	135	158	187	226	275	336	411								
16	109	124	137	150	164	181	203	232	269	315	373	444	530								
18	147	170	190	209	230	255	284	320	364	419	486	567	664								
20	190	222	250	278	307	339	376	420	473	537	614	705	813	939	1,086	1,255					
22	239	281	319	356	394	435	481	534	596	669	756	857	976	1,115	1,275	1,458					
24	293	346	395	443	491	542	598	661	733	816	913	1,025	1,155	1,306	1,478	1,675					
26	352	418	480	539	599	660	727	800	883	977	1,084	1,208	1,349	1,512	1,696	1,906					
28	497	572	644	716	790	868	953	1,047	1,152	1,271	1,405	1,559	1,732	1,929	2,152						
30	583	672	759	844	931	1,022	1,119	1,224	1,341	1,472	1,618	1,783	1,968	2,177	2,411	2,673	2,966	3,292	3,653	4,051	
32	675	781	882	982	1,083	1,187	1,297	1,416	1,545	1,687	1,845	2,022	2,219	2,439	2,685	2,959	3,263	3,600	3,973	4,384	
34		897	1,015	1,130	1,246	1,365	1,489	1,621	1,763	1,918	2,088	2,276	2,484	2,716	2,972	3,257	3,572	3,920	4,303	4,725	
36		1,021	1,156	1,289	1,421	1,555	1,694	1,840	1,995	2,163	2,345	2,545	2,765	3,007	3,274	3,569	3,894	4,251	4,643	5,074	
38		1,307	1,458	1,607	1,757	1,911	2,072	2,242	2,423	2,618	2,829	3,060	3,313	3,590	3,894	4,227	4,593	4,993	5,430		
40		1,467	1,637	1,804	1,972	2,142	2,318	2,502	2,697	2,905	3,129	3,371	3,634	3,920	4,233	4,574	4,946	5,352	5,795		
42		1,636	1,826	2,012	2,198	2,386	2,578	2,777	2,986	3,207	3,443	3,696	3,969	4,264	4,584	4,932	5,310	5,721	6,167		
44		1,814	2,025	2,232	2,437	2,643	2,852	3,067	3,290	3,525	3,772	4,036	4,319	4,622	4,950	5,303	5,686	6,099	6,547		
46		2,001	2,235	2,463	2,688	2,913	3,139	3,371	3,609	3,857	4,117	4,391	4,683	4,995	5,328	5,687	6,072	6,488	6,935		
48		2,198	2,455	2,705	2,951	3,195	3,440	3,688	3,942	4,204	4,476	4,761	5,062	5,381	5,720	6,082	6,470	6,885	7,331		
50		2,403	2,685	2,959	3,227	3,491	3,755	4,021	4,290	4,566	4,851	5,146	5,456	5,782	6,126	6,491	6,879	7,293	7,735		
52			3,223	3,514	3,800	4,084	4,367	4,653	4,943	5,240	5,546	5,864	6,196	6,544	6,911	7,299	7,710	8,146			
54			3,499	3,814	4,122	4,426	4,728	5,030	5,335	5,645	5,961	6,287	6,625	6,976	7,344	7,730	8,136	8,566			
56			3,786	4,126	4,457	4,782	5,103	5,422	5,742	6,064	6,391	6,725	7,068	7,422	7,789	8,172	8,573	8,993			
58			4,085	4,450	4,805	5,152	5,492	5,829	6,164	6,499	6,836	7,177	7,525	7,881	8,247	8,625	9,019	9,428			
60			4,394	4,786	5,166	5,535	5,896	6,251	6,601	6,948	7,296	7,644	7,996	8,353	8,717	9,090	9,474	9,872			
62						5,932	6,314	6,687	7,053	7,413	7,770	8,125	8,481	8,838	9,199	9,566	9,940	10,322			
64						6,343	6,746	7,138	7,520	7,893	8,260	8,622	8,980	9,337	9,694	10,052	10,414	10,781			
66						6,768	7,193	7,603	8,001	8,388	8,764	9,132	9,493	9,849	10,201	10,550	10,899	11,248			
68						7,206	7,654	8,084	8,498	8,897	9,284	9,658	10,021	10,375	10,721	11,060	11,393	11,723			
70						7,658	8,129	8,579	9,010	9,422	9,818	10,198	10,562	10,914	11,252	11,580	11,897	12,205			
72								9,089	9,536	9,962	10,367	10,752	11,118	11,466	11,797	12,111	12,410	12,695			
74								9,613	10,078	10,517	10,931	11,321	11,688	12,032	12,353	12,654	12,933	13,193			
76								10,152	10,634	11,087	11,510	11,905	12,272	12,611	12,922	13,207	13,466	13,699			
78								10,706	11,172	11,672	12,104	12,504	12,870	13,203	13,504	13,772	14,009	14,213			
80								11,274	11,792	12,272	12,713	13,117	13,482	13,809	14,097	14,348	14,561	14,735			

^{1/} Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.

NOTE.--Block indicates extent of data.

Table 16.—Cubic-foot volume of California red fir

Top diameter, 4 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches	Total height--Feet																	
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	
6	3	4	5	5	6	7	8	9	9	10	11	12	13					
8	5	7	8	10	11	13	14	15	17	18	20	21	22					
10	8	10	13	15	17	20	22	24	26	28	31	33	35					
12	10	14	18	22	25	28	31	35	38	41	44	47	50					
14	13	18	23	28	34	38	43	47	51	56	60	64	68					
16	17	22	28	35	42	49	56	61	67	73	78	84	89					
18	21	27	34	42	50	59	69	78	85	92	99	106	113					
20	26	33	41	50	60	70	81	93	105	113	122	131	140	148	157	166		
22	32	40	49	59	70	82	95	108	122	136	148	158	169	180	190	201		
24	38	47	57	69	82	95	110	125	140	157	174	188	201	214	226	239		
26	44	55	66	79	94	109	125	142	160	178	198	218	236	251	265	280		
28		64	77	90	107	124	142	161	181	201	223	245	268	291	308	325		
30		74	88	103	120	140	160	181	203	225	249	274	300	326	353	373	393	
32		84	101	117	135	156	178	202	226	251	277	304	333	362	392	423	447	
34			113	132	151	174	198	224	250	278	307	336	367	399	432	466	501	
36			127	148	170	192	219	247	276	306	337	370	403	438	473	510	548	
38				165	189	213	241	271	303	335	369	405	441	478	517	557	598	
40				183	209	236	263	296	331	366	403	441	480	521	562	605	649	
42				202	231	260	289	323	360	398	438	479	521	565	610	656	703	
44				222	253	285	317	350	390	432	474	518	564	611	659	708	759	
46				242	277	312	346	381	422	466	512	559	608	658	709	762	817	
48				264	302	339	377	415	455	502	551	602	654	707	762	818	876	
50				286	327	368	409	450	491	540	592	646	701	758	816	876	938	
52						398	442	487	531	578	634	691	750	811	873	936	1,002	
54						429	477	525	573	620	678	738	801	865	931	998	1,067	
56						462	513	564	616	667	722	787	853	921	991	1,062	1,135	
58						495	550	605	661	716	771	837	907	979	1,052	1,128	1,205	
60						530	589	648	707	766	825	889	962	1,038	1,116	1,196	1,277	
62									755	818	881	943	1,020	1,100	1,181	1,265	1,351	
64									804	871	938	1,005	1,078	1,162	1,249	1,337	1,427	
66									855	927	998	1,069	1,140	1,227	1,318	1,410	1,504	
68									908	984	1,059	1,135	1,211	1,293	1,388	1,485	1,584	
70									962	1,042	1,122	1,203	1,283	1,363	1,461	1,563	1,666	
72											1,188	1,272	1,357	1,442	1,535	1,642	1,750	
74											1,254	1,344	1,434	1,523	1,613	1,723	1,836	
76											1,323	1,418	1,512	1,607	1,701	1,806	1,924	
78											1,394	1,493	1,593	1,692	1,792	1,891	2,014	
80											1,466	1,571	1,676	1,780	1,885	1,990	2,106	

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.

NOTE.--Block indicates extent of data.

Table 17.—Board-foot volume of California red fir by International 1/4-inch rule

Top diameter, 6.5 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches ^{1/}	Total height--Feet																
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
10	38	51	66	84	105	129	157	189	227	269	318	372	433				
12	54	72	92	115	142	173	209	250	296	349	409	477	552				
14	73	95	121	150	184	223	267	317	374	438	511	591	681				
16	94	122	154	191	232	279	332	392	460	536	621	716	822				
18	117	153	192	236	285	341	404	474	554	642	741	851	973				
20	144	187	233	286	344	409	482	564	656	758	871	996	1,135	1,288	1,455	1,638	
22	173	224	279	340	408	483	568	661	766	881	1,010	1,152	1,308	1,479	1,667	1,872	
24	205	264	329	399	477	564	660	766	884	1,014	1,158	1,317	1,491	1,683	1,892	2,119	
26	240	308	382	463	552	650	758	878	1,010	1,155	1,316	1,492	1,686	1,897	2,128	2,379	
28		355	440	532	632	742	864	997	1,144	1,306	1,483	1,678	1,891	2,123	2,376	2,652	
30		406	502	605	718	841	976	1,124	1,286	1,465	1,660	1,873	2,107	2,361	2,637	2,937	3,262
32		460	567	683	809	946	1,095	1,258	1,437	1,632	1,846	2,079	2,333	2,610	2,910	3,235	3,587
34			637	766	905	1,056	1,220	1,400	1,595	1,809	2,041	2,295	2,571	2,870	3,195	3,546	3,926
36			711	853	1,007	1,173	1,353	1,549	1,762	1,994	2,246	2,521	2,819	3,142	3,492	3,870	4,278
38				946	1,114	1,296	1,492	1,705	1,936	2,188	2,461	2,757	3,078	3,425	3,801	4,207	4,644
40				1,043	1,226	1,424	1,638	1,869	2,119	2,390	2,684	3,003	3,347	3,720	4,122	4,556	5,023
42				1,144	1,344	1,559	1,790	2,040	2,310	2,602	2,918	3,259	3,628	4,026	4,456	4,918	5,415
44				1,251	1,468	1,700	1,950	2,219	2,509	2,822	3,160	3,525	3,919	4,344	4,801	5,293	5,821
46				1,362	1,596	1,847	2,116	2,405	2,716	3,051	3,412	3,802	4,221	4,673	5,159	5,681	6,241
48				1,477	1,730	2,000	2,289	2,598	2,931	3,289	3,674	4,088	4,534	5,013	5,528	6,081	6,674
50				1,598	1,870	2,159	2,468	2,799	3,154	3,535	3,945	4,385	4,858	5,365	5,910	6,494	7,120
52						2,324	2,654	3,007	3,385	3,790	4,225	4,691	5,192	5,729	6,304	6,921	7,580
54						2,495	2,847	3,223	3,624	4,054	4,515	5,008	5,537	6,104	6,710	7,359	8,053
56							2,673	3,047	3,446	3,872	4,327	4,814	5,335	5,893	6,490	7,129	7,811
58							2,856	3,254	3,677	4,127	4,608	5,123	5,672	6,260	6,888	7,559	8,276
60							3,045	3,467	3,914	4,391	4,899	5,441	6,019	6,637	7,297	8,001	8,753
62									4,662	5,198	5,768	6,376	7,025	7,718	8,456	9,243	10,081
64									4,942	5,505	6,105	6,744	7,424	8,150	8,923	9,746	10,622
66									5,230	5,822	6,451	7,121	7,834	8,593	9,401	10,261	11,176
68									5,526	6,147	6,807	7,509	8,255	9,048	9,892	10,790	11,744
70									5,830	6,481	7,172	7,906	8,686	9,515	10,395	11,331	12,325
72											7,547	8,314	9,128	9,993	10,911	11,885	12,920
74											7,931	8,732	9,581	10,482	11,438	12,452	13,528
76											8,324	9,160	10,045	10,983	11,977	13,032	14,149
78											8,727	9,598	10,519	11,495	12,529	13,624	14,784
80											9,139	10,046	11,004	12,019	13,093	14,229	15,432

^{1/} Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.

NOTE.--Block indicates extent of data.

Table 18.—Board-foot volume of California red fir by Scribner rule in 16-foot logs to a utilized top

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Diameter breast height outside bark-- Inches	Total height--Feet																	
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	
12	24	41	60	81	105	133	164	199	239	284	334	390	452					
14	38	60	84	112	142	177	215	259	308	363	424	491	566					
16	54	82	113	147	185	227	274	327	385	451	523	603	692					
18	74	108	146	187	233	284	340	402	471	548	633	726	828					
20	96	138	183	232	287	346	412	485	565	654	752	859	976	1,105	1,245	1,398		
22	121	171	224	283	346	416	492	576	668	769	880	1,002	1,135	1,280	1,438	1,610		
24	149	207	270	337	411	491	578	674	779	894	1,019	1,156	1,305	1,468	1,644	1,836		
26	179	247	320	397	481	573	672	780	898	1,027	1,167	1,320	1,487	1,667	1,863	2,075		
28		290	373	462	557	661	772	894	1,026	1,169	1,325	1,495	1,679	1,878	2,094	2,327		
30		337	431	532	639	755	880	1,015	1,162	1,321	1,493	1,680	1,882	2,101	2,338	2,593	2,867	
32		388	494	606	726	855	994	1,144	1,306	1,481	1,671	1,876	2,097	2,336	2,594	2,871	3,170	
34			560	685	819	962	1,115	1,281	1,459	1,651	1,858	2,082	2,323	2,583	2,863	3,163	3,487	
36			631	770	917	1,075	1,244	1,425	1,620	1,829	2,055	2,298	2,560	2,841	3,144	3,469	3,817	
38				859	1,021	1,194	1,379	1,577	1,789	2,017	2,262	2,525	2,808	3,112	3,438	3,787	4,161	
40				953	1,131	1,320	1,521	1,737	1,967	2,214	2,479	2,763	3,067	3,394	3,744	4,119	4,520	
42				1,051	1,246	1,452	1,671	1,904	2,153	2,420	2,705	3,010	3,338	3,688	4,063	4,464	4,892	
44				1,155	1,366	1,590	1,827	2,079	2,348	2,634	2,941	3,269	3,619	3,994	4,394	4,822	5,278	
46				1,264	1,493	1,734	1,990	2,261	2,550	2,858	3,187	3,537	3,912	4,312	4,738	5,193	5,678	
48				1,377	1,624	1,885	2,160	2,452	2,762	3,091	3,442	3,817	4,216	4,641	5,095	5,578	6,093	
50				1,496	1,762	2,042	2,337	2,650	2,981	3,333	3,708	4,106	4,531	4,983	5,464	5,976	6,521	
52					2,205	2,521	2,855	3,209	3,584	3,983	4,406	4,857	5,336	5,845	6,387	6,963		
54					2,374	2,712	3,069	3,445	3,844	4,268	4,717	5,194	5,701	6,239	6,811	7,418		
56					2,550	2,910	3,289	3,690	4,114	4,562	5,038	5,543	6,078	6,646	7,249	7,888		
58					2,732	3,115	3,518	3,943	4,392	4,867	5,369	5,902	6,467	7,065	7,700	8,372		
60					2,920	3,327	3,754	4,204	4,679	5,181	5,711	6,273	6,867	7,497	8,164	8,870		
62								4,474	4,976	5,505	6,064	6,655	7,280	7,941	8,641	9,381		
64								4,752	5,281	5,838	6,427	7,048	7,704	8,398	9,132	9,907		
66								5,039	5,595	6,182	6,800	7,452	8,140	8,867	9,635	10,446		
68								5,333	5,919	6,535	7,184	7,867	8,588	9,349	10,152	11,000		
70								5,637	6,252	6,898	7,578	8,294	9,048	9,844	10,683	11,567		
72										7,270	7,982	8,731	9,520	10,351	11,226	12,149		
74										7,653	8,397	9,180	10,004	10,870	11,783	12,744		
76										8,045	8,823	9,640	10,499	11,402	12,353	13,353		
78										8,447	9,259	10,111	11,006	11,947	12,936	13,976		
80										8,859	9,705	10,593	11,525	12,504	13,532	14,613		

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 19.—Cubic-foot volume of incense-cedar

Top diameter, 4 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches ^{1/}	Total height--Feet															
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
6	3	3	4	4	4	5	5	6	6	7	7	8	8			
8	5	5	6	7	8	9	9	10	11	12	13	14	15			
10	7	9	10	11	12	14	15	16	18	19	21	22	24			
12	11	12	14	16	18	19	21	23	25	28	30	32	34			
14	14	17	19	22	24	26	29	32	35	38	40	43	46			
16	19	22	25	28	31	35	38	41	45	49	53	57	60			
18	24	28	32	36	40	44	48	52	57	62	67	72	76			
20	29	34	39	44	49	54	59	65	71	77	82	88	94	100	106	
22	36	42	47	53	59	65	71	78	86	93	100	107	114	121	128	
24	42	49	57	64	71	78	85	93	102	110	119	127	136	144	153	
26	50	58	66	75	83	91	100	110	119	129	139	149	159	169	179	
28	67	77	87	96	106	116	127	139	150	162	173	185	196	208		
30	77	88	99	110	122	133	146	159	172	186	199	212	225	239		
32	88	100	113	126	138	151	166	181	196	211	226	241	256	271		
34		113	128	142	156	170	187	204	221	238	255	272	289	306		
36		127	143	159	175	191	210	229	248	267	286	305	324	344		
38			159	177	195	213	234	255	276	298	319	340	361	383		
40			177	196	216	236	259	283	306	330	353	377	401	424		
42			195	217	238	260	286	312	338	364	390	416	442	468		
44			214	238	261	285	314	342	371	399	428	456	485	513		
46			234	260	286	312	343	374	405	436	467	499	530	561		
48			254	283	311	340	373	407	441	475	509	543	577	611		
50			276	307	338	368	405	442	479	515	552	589	626	663		
52					365	399	438	478	518	557	597	637	677	717		
54					394	430	472	515	558	601	644	687	730	773		
56					424	462	508	554	600	647	693	739	785	831		
58					454	496	545	594	644	694	743	793	842	892		
60					486	531	583	636	689	742	795	848	901	954		
62					519	567	623	679	736	793	849	906	962	1,019		
64					553	604	664	724	784	844	905	965	1,025	1,086		
66					588	642	706	770	834	898	962	1,026	1,091	1,155		
68								817	885	953	1,021	1,090	1,158	1,226		
70								866	938	1,010	1,082	1,155	1,227	1,299		
72										1,069	1,145	1,221	1,298	1,374		
74										1,129	1,210	1,290	1,371	1,452		
76										1,191	1,276	1,361	1,446	1,531		
78										1,254	1,344	1,434	1,523	1,613		
80										1,319	1,414	1,508	1,602	1,696		

^{1/} Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 20.—Board-foot volume of incense-cedar by International 1/4-inch rule

Top diameter, 6.5 inches
Stump height, 1 foot

Stump and top excluded

Diameter breast height outside bark-- inches--	Total height--Feet														
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
10	31	40	49	58	68	79	90	102	116	130	145	162	180		
12	45	57	70	84	98	113	130	147	166	187	209	233	259		
14	61	78	95	114	133	154	177	201	227	255	285	317	352		
16	80	102	125	149	174	201	231	262	296	332	372	414	460		
18	101	129	158	188	220	255	292	332	375	421	470	524	582		
20	125	159	195	232	272	315	360	410	462	519	581	647	718	795	877
22	151	192	235	281	329	381	436	496	560	629	703	783	869	962	1,061
24	180	229	280	334	392	453	519	590	666	748	836	932	1,034	1,144	1,263
26	212	269	329	392	460	532	609	692	782	878	982	1,093	1,214	1,343	1,483
28		312	381	455	533	617	707	803	906	1,018	1,138	1,268	1,408	1,558	1,719
30		358	438	522	612	708	811	922	1,041	1,169	1,307	1,456	1,616	1,788	1,974
32		407	498	594	696	806	923	1,049	1,184	1,330	1,487	1,656	1,838	2,035	2,246
34			562	671	786	910	1,042	1,184	1,337	1,501	1,678	1,870	2,075	2,297	2,535
36			630	752	882	1,020	1,168	1,327	1,498	1,683	1,882	2,096	2,327	2,575	2,842
38				838	982	1,136	1,301	1,479	1,670	1,875	2,097	2,335	2,592	2,869	3,167
40				928	1,088	1,259	1,442	1,638	1,850	2,078	2,323	2,588	2,873	3,179	3,509
42				1,024	1,200	1,388	1,590	1,806	2,040	2,291	2,561	2,853	3,167	3,505	3,869
44				1,123	1,317	1,523	1,745	1,983	2,238	2,514	2,811	3,131	3,476	3,847	4,246
46				1,228	1,439	1,665	1,907	2,167	2,447	2,748	3,072	3,422	3,799	4,204	4,641
48				1,337	1,567	1,813	2,076	2,359	2,664	2,992	3,345	3,726	4,136	4,578	5,053
50				1,451	1,700	1,967	2,253	2,560	2,890	3,246	3,630	4,043	4,488	4,967	5,483
52					2,128	2,437	2,769	3,126	3,511	3,926	4,373	4,855	5,373	5,930	
54					2,294	2,628	2,986	3,371	3,787	4,234	4,716	5,235	5,794	6,395	
56					2,468	2,826	3,211	3,626	4,072	4,553	5,072	5,630	6,231	6,877	
58					2,647	3,032	3,445	3,889	4,368	4,884	5,441	6,039	6,684	7,377	
60					2,833	3,244	3,686	4,162	4,675	5,227	5,822	6,463	7,153	7,895	
62					3,025	3,464	3,936	4,444	4,992	5,581	6,217	6,901	7,638	8,430	
64					3,223	3,691	4,194	4,736	5,319	5,947	6,624	7,354	8,139	8,983	
66					3,428	3,926	4,461	5,036	5,657	6,325	7,045	7,820	8,655	9,553	
68								5,346	6,005	6,714	7,478	8,302	9,188	10,141	
70								5,665	6,363	7,115	7,925	8,797	9,736	10,746	
72										7,527	8,384	9,307	10,300	11,369	
74										7,951	8,856	9,831	10,881	12,009	
76										8,387	9,341	10,370	11,477	12,667	
78										8,834	9,840	10,923	12,089	13,343	
80										9,293	10,351	11,490	12,717	14,036	

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 21.—Board-foot volume of incense-cedar by Scribner rule in 16-foot logs to a utilized top

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Diameter breast height outside bark-- inches ^{1/}	Total height--Feet														
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
12	27	33	40	46	53	60	66	73	80	86	93	99	106		
14	42	53	63	74	84	95	105	116	126	137	147	158	168		
16	61	76	91	106	122	137	152	167	182	198	213	228	243		
18	83	103	124	145	165	186	207	227	248	269	289	310	331		
20	108	135	162	189	216	242	269	296	323	350	377	404	431	458	485
22	136	170	204	238	272	306	340	374	408	442	476	510	544	578	612
24	167	209	251	293	335	377	419	460	502	544	586	628	670	712	754
26	202	253	303	354	404	455	505	556	606	657	707	758	808	859	909
28		300	360	420	480	540	600	660	720	780	839	899	959	1,019	1,079
30		351	421	491	562	632	702	772	842	913	983	1,053	1,123	1,193	1,264
32		406	487	569	650	731	812	894	975	1,056	1,137	1,219	1,300	1,381	1,462
34			558	651	745	838	931	1,024	1,117	1,210	1,303	1,396	1,489	1,582	1,675
36			634	740	846	951	1,057	1,163	1,268	1,374	1,480	1,585	1,691	1,797	1,903
38				834	953	1,072	1,191	1,310	1,429	1,548	1,668	1,787	1,906	2,025	2,144
40				933	1,067	1,200	1,333	1,467	1,600	1,733	1,867	2,000	2,133	2,267	2,400
42				1,038	1,187	1,335	1,483	1,632	1,780	1,928	2,077	2,225	2,373	2,522	2,670
44				1,149	1,313	1,477	1,641	1,806	1,970	2,134	2,298	2,462	2,626	2,790	2,955
46				1,265	1,446	1,627	1,807	1,988	2,169	2,350	2,530	2,711	2,892	3,073	3,253
48				1,387	1,585	1,783	1,981	2,179	2,378	2,576	2,774	2,972	3,170	3,368	3,566
50				1,514	1,731	1,947	2,163	2,379	2,596	2,812	3,028	3,245	3,461	3,677	3,894
52						2,118	2,353	2,588	2,824	3,059	3,294	3,529	3,765	4,000	4,235
54						2,296	2,551	2,806	3,061	3,316	3,571	3,826	4,081	4,336	4,591
56						2,481	2,756	3,032	3,308	3,583	3,859	4,135	4,410	4,686	4,962
58						2,673	2,970	3,267	3,564	3,861	4,158	4,455	4,752	5,049	5,346
60						2,872	3,192	3,511	3,830	4,149	4,468	4,787	5,107	5,426	5,745
62						3,079	3,421	3,763	4,105	4,448	4,790	5,132	5,474	5,816	6,158
64						3,293	3,659	4,025	4,390	4,756	5,122	5,488	5,854	6,220	6,586
66						3,514	3,904	4,294	4,685	5,075	5,466	5,856	6,247	6,637	7,027
68								4,989	5,405	5,820	6,236	6,652	7,068	7,483	7,898
70								5,303	5,744	6,186	6,628	7,070	7,512	7,954	8,396
72										6,563	7,032	7,501	7,970	8,438	8,906
74										6,951	7,448	7,944	8,441	8,937	9,433
76										7,351	7,876	8,401	8,926	9,451	9,976
78										7,761	8,315	8,870	9,424	9,978	10,532
80										8,182	8,767	9,351	9,936	10,520	

^{1/} Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 22—Root mean squared errors of form factor equations

Species	Root mean squared error					
	Cubic		International 1/4-inch		Scribner	
	Ratio	Percent	Ratio	Percent	Ratio	Percent
Douglas-fir	0.04	11.7	0.31	14.8	0.32	17.3
Ponderosa and Jeffrey pine	.05	13.4	.40	17.6	.41	20.9
Sugar pine	.05	15.5	.44	19.3	.45	21.7
Lodgepole pine	.04	10.9	.32	13.6	.33	16.6
White fir	.04	13.2	.37	17.0	.36	18.9
California red fir	.04	13.5	.38	18.0	.38	20.3
Incense-cedar	.04	14.6	.31	19.0	.29	21.6

Table 23—Results of a test of study equations and the old local volume tables against 441 trees of known volume from the Stanislaus National Forest

Species and log rule	Mean volume per tree	Root mean squared error ^{1/}		Aggregate difference	
		Study equations	Old local volume tables	Study equations	Old local volume tables
----- Percent -----					
Douglas-fir (15 trees):					
Cubic	114.6	19.2	27.7	10.1	-0.5
International 1/4-inch	780.6	24.9	51.0	9.1	-8.3
Scribner	677.1	31.1	48.1	10.7	-1.2
Ponderosa and Jeffrey pine (146 trees):					
Cubic	158.9	20.2	31.7	4.6	-8.5
International 1/4-inch	1,120.1	26.9	56.7	2.0	-17.0
Scribner	1,009.2	29.5	49.5	3.4	-13.3
Sugar pine (34 trees):					
Cubic	214.5	13.0	20.8	-5.2	-6.7
International 1/4-inch	1,546.5	17.6	32.1	-10.3	-13.9
Scribner	1,417.6	43.0	38.0	-9.9	-10.9
Lodgepole pine (60 trees):					
Cubic	79.0	15.8	50.5	3.8	35.0
International 1/4-inch	457.2	25.4	60.0	7.9	36.2
Scribner	411.6	30.0	77.4	4.7	41.0
White fir (86 trees):					
Cubic	168.3	15.7	22.4	-6.2	-10.8
International 1/4-inch	1,197.6	21.4	31.2	-9.7	-15.0
Scribner	1,096.7	38.1	52.4	-9.8	-12.5
California red fir (42 trees):					
Cubic	284.9	17.2	28.3	-2.6	-.1
International 1/4-inch	2,044.0	24.8	33.4	-10.2	-5.2
Scribner	1,892.6	28.1	27.4	-10.7	-2.5
Incense-cedar (58 trees):					
Cubic	117.3	20.5	39.2	-.6	-20.7
International 1/4-inch	769.9	28.1	52.8	-2.5	-23.1
Scribner	679.4	51.7	65.7	-5.0	-17.9
Combined (441 trees):					
Cubic	159.2	17.9	32.9	-.3	-5.4
International 1/4-inch	1,108.1	24.9	47.5	-3.8	-11.6
Scribner	1,005.9	34.8	43.8	-3.9	-8.1

^{1/} Logarithmic transformation was used to equalize variance.

Table 24—Comparative reliability of diameter-height and diameter-height-form class volume equations in estimating Stanislaus National Forest sample tree volumes
(In percent)

Equation	Cubic		International 1/4-inch		Scribner	
	Root mean squared error ^{1/}	Aggregate difference	Root mean squared error ^{1/}	Aggregate difference	Root mean squared error ^{1/}	Aggregate difference
Without form class	16.2	-0.6	20.1	-4.5	23.3	-4.4
With actual form class	12.0	5.4	13.0	1.7	16.3	1.7
With average form class	16.2	-1.8	20.5	-5.7	23.7	-5.5

^{1/} In order to equalize variance, root mean squared errors were calculated for four factors instead of volume.

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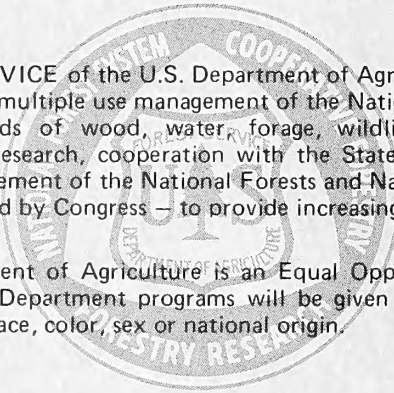
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